ARMY RESEARCH LABORATORY

Manpower-Based System Evaluation Aid (MAN-SEVAL)

Sue Dahl

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prepared by

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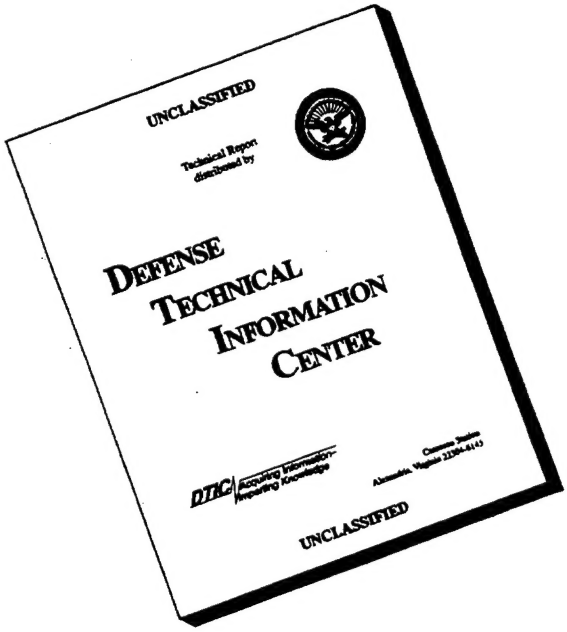

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This manual is for the HARDMAN III module MAN-SEVAL (manpower-based system evaluation aid).

The MAN-SEVAL manual is divided into nine sections: Introduction, Installing MAN-SEVAL, Getting Around in MAN-SEVAL, Overview of Steps in MAN-SEVAL, MAN-SEVAL Tutorial, Recommended Strategy for Using MAN-SEVAL, Help System and Utilities, Glossary, and Index. The manual also has four appendices: Error Messages, Description of HARDMAN III Tools, User Comments, and Flow Diagram of MAN-SEVAL Steps.

MAN-SEVAL is a tool to evaluate contractor's designs very early in the weapon system acquisition process. MAN-SEVAL can help determine whether a design is likely to meet the system performance requirements with the maintenance and operator crew sizes that will be available to operate and maintain the system once it is fielded. MAN-SEVAL is intended to be used iteratively. As more data become available during design phase, the MAN-SEVAL data can be updated to refine the performance predictions that are generated by the tool.

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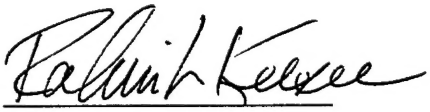
APPROVED: 

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MANPOWER-BASED SYSTEM EVALUATION AID (MAN-SEVAL)
USER'S MANUAL

SECTION 1 - INTRODUCTION

The purpose of the manpower-based system evaluation aid (MAN-SEVAL) is to provide you with a tool to evaluate contractors' designs very early in the weapon system acquisition process. MAN-SEVAL can help you determine whether a design is likely to meet the system performance requirements with the maintenance and operator crew sizes that will be available when the system is fielded. MAN-SEVAL can be used during the Proof-of-Principle Phase, after the contractor submits the initial designs but before one design is chosen to develop into a prototype.

MAN-SEVAL is intended to be used iteratively. As more data become available during the design phase, the MAN-SEVAL data can be updated to refine the performance predictions that are generated by the tool.

MAN-SEVAL AND THE OTHER HARDMAN III PRODUCTS

Ideally, the system performance requirements will be input into MAN-SEVAL automatically from a previous analysis of your system using the System Performance and Reliability, Availability, Maintainability (RAM) Criterion Estimation Aid (SPARC), also known as Product 1 of the Hardware and Manpower (HARDMAN) III project. In addition, the Manpower Constraints Estimation Aid (M-CON), also known as Product 2, can be used to predict the crew sizes that will be available for your system. MAN-SEVAL's output will be used with the output from the Personnel-Based System Evaluation Aid (PER-SEVAL), or Product 6. The combined output will help develop manpower, personnel, and training (MPT) alternatives that ensure that the types and numbers of people needed to support the new system will be available when it is fielded.

MAN-SEVAL OUTPUTS

MAN-SEVAL will help you determine manpower requirements for each contractor design. These requirements include

1. the jobs associated with each design
2. the tasks associated with each job
3. the number of operators or maintainers in each job.

In addition to defining manpower requirements by job or duty position, MAN-SEVAL assigns each job to a military occupational specialty (MOS) and calculates total manpower requirements by MOS, skill level, major component item (for maintainers only), and maintenance level (for maintainers only). MAN-SEVAL also estimates system availability, reliability, and operational effectiveness.

For operators, MAN-SEVAL assists in assigning workload to each operator task, as well as performance estimates for each task. These values are used to provide workload profiles for the missions that the system will perform and performance estimates of the time it will take the operators to complete the mission.

THE TWO TOOLS OF MAN-SEVAL

We have split MAN-SEVAL into two distinct tools. The first tool, called the Workload Analysis Aid (WAA), predicts manpower requirements for operators of systems. The second tool, called the Maintenance Manpower Analysis Aid (MMAA), predicts manpower requirements for maintainers of systems. Although both tools rely on computer simulation to perform their analyses, the details of using each tool are different.

To use WAA, a network of tasks that must be performed during specific mission scenarios will be developed. Next, WAA will help assign the tasks to operators. The initial allocation of tasks to operators represents the first "hypothesis" about how tasks should be allocated to jobs. Then, WAA will test this hypothesis against three constraints:

1) Workload constraint - can the operators perform the tasks in the allotted time and still maintain a reasonable level of workload?

2) Performance constraint - can the operators meet system performance requirements?

3) Accessibility constraint - can the operators reach and see the controls and displays they need to perform the tasks they have been assigned?

To use MMAA, enter the tasks required to maintain each component in the proposed system, how frequently each task needs to be performed, and what kinds of maintainers are needed to perform those tasks. MMAA will help define mission scenarios that include the amount that each component is used and the amount of time that is available for maintenance, given system availability requirements.

The output of your MMAA simulation will give you a report of the different maintenance jobs that were required during the analysis period, the tasks that were assigned to each maintenance job, the number of hours of maintenance that were required for each maintenance job, and the actual number of people that were required to maintain system availability for both mission requirements and the percentage of time that number were needed.

SECTION 2 - INSTALLING MAN-SEVAL

Before using MAN-SEVAL, you need to install the MAN-SEVAL software onto the hard disk of your computer. This section of the User's Manual provides you with step-by-step instructions for performing this activity.

SYSTEM REQUIREMENTS

To use MAN-SEVAL, your computer system must meet the following minimum configuration requirements:

- 386 or 486 processor
- Enhanced graphics display
- Hard disk with at least 20 megabytes (MB) of storage
- One floppy disk drive capable of reading from and writing to floppy diskettes
- One of the following three printer types: IBM Graphics, Epson, or HP LaserJet
- IBM AT-compatible keyboard
- DOS 3.0 or higher
- 640 kilobytes (kB) of random access memory (RAM)

Optional

- 80287 math coprocessor

You can use the MAN-SEVAL installation program to install the software for the first time or to update your version of MAN-SEVAL. The procedures for each are presented below.

INSTALLING THE SOFTWARE FOR THE FIRST TIME

To install the MAN-SEVAL software from floppy disks on a hard disk system, follow these steps:

(If you are installing the software from a CD, the instructions will be included with the CD.)

1. Turn on the computer and boot up the operating system.

2. Insert the first diskette labeled "MAN-SEVAL MMAA EXE 1 of _" into drive A. If your A drive is not the appropriate size or density for the MAN-SEVAL diskettes you have been given, you can insert them into drive B.

3. If you have inserted the diskette into drive A, at the DOS prompt (usually C:>), type: A:imaint

or

If you have inserted the diskette into drive B, at the DOS prompt type: B:imaint.

4. Press the "Enter" key.

5. The installation program (imaint) contains step-by-step directions for completing the installation procedure. Follow the prompts that appear on the screen.

Note. If you want to install the different pieces of MAN-SEVAL in different directories, you will be able to accomplish this using the installation procedure. Just follow the prompts as they are presented to you.

UPDATING YOUR VERSION OF MAN-SEVAL

If you are using this procedure to update your version of MAN-SEVAL and you already have data in your working files that you want to retain, follow these steps:

Important. If you are updating MAN-SEVAL from Version 1 to either Version 2 or Version 3, and you have some Version 1 working files that you want to convert to either of the new versions, do NOT proceed until you have consulted the TRAN5 User's Manual (this is the program that updates working files from Version 1.X). The library files have already been

converted. The TRAN5 software and User's Manual are available from the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD.

1. Turn on the computer and boot up the operating system.

2. Insert the first diskette labeled "MAN-SEVAL MMAA EXE 1 of _" into drive A. If your A drive is not the appropriate size or density for the MAN-SEVAL diskettes you have been given, you can insert them into drive B.

3. If you have inserted the diskette into drive A, at the DOS prompt (usually C:>), type: A:imaint.

or

If you have inserted the diskette into drive B, at the DOS prompt type: B:imaint.

4. Press the "Enter" key.

5. The installation procedure (imaint) contains step-by-step directions for completing the installation program. Follow the prompts that appear on the screen to "Install Selected Modules" in the installation procedure. Then, install only the MAN-SEVAL MMAA executables, the MAN-SEVAL WAA executables, the MAN-SEVAL MMAA library, the MAN-SEVAL WAA library, and the MAN-SEVAL help screens.

Note. If you install the MMAA or WAA working files, your existing working files will be overwritten. After installing MAN-SEVAL, you will be returned to the DOS prompt.

SECTION 3 - GETTING AROUND IN MAN-SEVAL

This section presents an introduction to using MAN-SEVAL. It is designed to help you quickly learn how to use the different types of screens and menus in MAN-SEVAL. It also describes ways to print information, how to get on-line help, how to use the navigation aid, and how to cancel a command.

UNDERSTANDING THE PARTS OF THE MAN-SEVAL SCREENS

All MAN-SEVAL screens have a few attributes in common:

• Path - At the top left of every screen, you will see a description of where you are in MAN-SEVAL. This description consists of a list of the steps you have taken to get to your current location.

• Screen Title - Centered on the first line of every pop-up screen is the screen title. This title describes the contents of the list of options on the screen.

• Option List - The body of each screen consists of a list of items from which you can select.

• Command Bar - The last line in most screens includes the commands that can be applied to each item in the option list.

SELECTING FROM MAN-SEVAL MENUS

Most of the MAN-SEVAL screens consist of a list of options in the center of the screen and a command bar at the bottom of the screen. The vertical arrow keys, "PgUp," "PgDn," "Home," and "End" will position the highlight on the option you want. The horizontal arrow keys will move the highlight between the commands in the command bar. To use the screens, you will highlight an item listed in the screen and a command listed at the bottom of the screen. When you press the "Enter" key, you will be telling MAN-SEVAL to execute the command on the highlighted item.

Note. Small arrows will display on the command bar when there is more information than can be displayed on the current menu. You should use the up and down arrows on your keyboard to scroll the menu so that you can see more.

PRINTING INFORMATION

On many of the screens, there is a print command that you can use to print the information on the screen. When you select this command, a print menu is displayed where you have the option of sending the information to a printer or to a file. If you select sending the information to a file, you can use the default filename or edit it to specify another filename and where to save the file.

USING ON-LINE HELP

For a brief description of each option on any menu, you can use the on-line HELP feature. To use HELP, press the "F1" key at any time. You will notice that at the bottom of the HELP screen there is a message regarding how you can get a HELP message containing data sources and the MAN-SEVAL glossary.

- Data Sources - If you have questions regarding the source of any data that are presented currently on the screen, press the "D" key. If you are at a place in MAN-SEVAL where the data source HELP is not appropriate (probably because either they are data you have entered yourself or you are at a menu that does not have data attached to it), you will see a message that says the data sources are not available.

- Glossary - If you have questions regarding any of the acronyms that are used in MAN-SEVAL, press the "G" key. This displays the MAN-SEVAL glossary.

When you want to leave HELP and return to your work in MAN-SEVAL, press any key.

USING THE NAVIGATION AID

MAN-SEVAL has a navigation aid which is a graphical map of the various MAN-SEVAL screens. You can use this to determine how to get to another screen or to see where you are. You can display the navigation aid by pressing "F2" at any time. When the map is displayed, the box that is highlighted shows you where you were when you pressed "F2." Commands at the bottom of the screen allow you to zoom back and see more of the map, or move close to see a more specific area of the map. When you want to leave the navigation aid, press the "Esc" key.

CANCELING COMMANDS

The escape key ("Esc") acts as a cancel command in MAN-SEVAL. If you want to cancel a selection you have made, press the "Esc" key. The escape key will always erase the last thing you did. MAN-SEVAL will warn you if you try to exit without saving a change you made (in case you did not want to lose your changes).

SECTION 4 - OVERVIEW OF STEPS IN MAN-SEVAL

As explained in the first section of this User's Manual, MAN-SEVAL helps you predict the crew sizes that will be necessary to operate and maintain your system. Section 1 also discussed the division of MAN-SEVAL into two pieces. The first is used to analyze the operators' tasks and is called WAA. The second tool is used to analyze the maintenance tasks and is called MMAA. In this section, we briefly explain each of the steps you will take in using WAA and MMAA to accomplish these tasks.

WAA STEPS

Use WAA to specify the mission that the system is expected to accomplish. This section summarizes the steps necessary to describe the mission you have identified.

Step 1: Defining the conditions under which your mission will be performed. In the first step, you will specify the conditions that apply to the mission. Only those conditions that are appropriate for your system type are presented. For example, if you are analyzing a helicopter mission, you will be asked to identify the wind speed. If you are analyzing a howitzer mission, you will be asked to select a terrain type from a list that is already in WAA.

Step 2: Entering the mission level data. In this step, you will specify the overall mission time standard and the mission description.

Step 3: Identifying the mission's functions. You will list the functions that constitute your mission. If you have chosen a mission from the library, this list will already exist and you can modify it. Also, you will identify the sequence in which these functions will be performed during the mission.

Step 4: Identifying each function's tasks. This step is similar to Step 3, except that you will break each function down into its tasks. Again, the WAA libraries will be available to help you with this step.

Step 5: Identifying the crew members who will operate your system. You will list the crew positions that perform the tasks listed in Step 4.

Step 6: Assigning the crew members to the tasks. You will indicate which crew members have access to the controls and displays that are necessary to perform each task. In addition, identify the crew member who is most likely to perform each task.

Step 7: Setting performance parameters. You will estimate the performance time and assign workload values to each task. The workload values reflect the amount of effort the crew members will have to expend to perform each task.

Step 8: Executing a model of the mission. You will specify the number of simulation runs and the seed number for the random number stream, and then you will execute the model. WAA uses the functions and tasks you defined in Steps 3 through 6 to automatically build and run a model of your mission.

Step 9: Analyzing the results of your mission model. Here, you will view the results of your model's execution. When the model ran, it used the performance times that you estimated to predict how well the mission would be performed. In the reports, WAA will tell you whether the model's predictions met the requirements entered in Step 3. If the predictions do not meet the minimally acceptable performance, WAA helps you change the task performance estimates to resolve the discrepancy.

Step 10: Displaying and printing reports. In this step, you may display and print various reports of the results of your mission simulation.

The preceding step descriptions summarize how WAA works. In Section 5, you are led through these steps. If you want to read more about WAA, please refer to the final technical report for this project. That report can be obtained from the Human Research and Engineering Directorate (HRED) of ARL at Aberdeen Proving Ground, Maryland.

MMAA STEPS

You will use MMAA to determine how much maintenance your system will need for a variety of scenarios. This section summarizes the steps that you will go through to describe the system you have identified.

Step 1: Developing the component maintenance parameters. Here, MMAA helps you break your system into its major subsystems and then break each subsystem into its components. For each of the components, you enter the following parameters:

- the maintenance type (preventative or corrective)
- the MOS that will perform the maintenance
- how often the maintenance will be required
- how long it will take to perform the maintenance
- the probability that the need for this maintenance will cause the system to abort an ongoing mission

Most of these data should be available from the contractor's design documents.

Step 2: Developing the maintenance scenario. In this step, you will enter the scenario you want to model. The scenario includes the following items:

- simulation time span
- mission length
- amount of time between missions
- amount of ammunition expended and distance traveled per mission
- size of maintenance manpower pool

Step 3: Executing a model of the maintenance scenario. Here, MMAA uses the information from Steps 1 and 2 to build and execute a model of the maintenance requirements for your system.

Step 4: Analyzing the results of your maintenance model. In this step, you will view the results of your model's execution. You have access to reports that include

- the number of maintenance man-hours required by your system for the scenario that was modeled
- the reliability of your system
- the availability of your system
- the maintainability of your system

The preceding step descriptions summarize how MMAA works. In Section 5, you are led through each of these steps. If you want to read more about MMAA, please refer to the final

technical report for this project. That report can be obtained from HRED of ARL at Aberdeen Proving Ground, Maryland.

SECTION 5 - MAN-SEVAL TUTORIAL

MAN-SEVAL is used to evaluate a new weapon system design based on information you enter. The information describes the operations and maintenance tasks for each mission that the weapon system will have to accomplish. MAN-SEVAL is subdivided into two tools for this purpose. Use WAA to define the operations tasks; use MMAA to analyze the maintenance tasks. The bases for both of these tools are computer simulation models of the weapon system's missions.

WAA OVERVIEW

WAA allows you to analyze a new weapon system by helping you build models of each mission that the weapon system will have to accomplish. You build these models by breaking the mission down into a network of functions. Each one of the functions is then broken down into a network of tasks. It is often easier to describe small parts of the mission than it is to describe the mission as a whole. By using the computer to perform the mission model simulation, you can study and analyze the range of results that occur in the mission by describing the variability of its elements.

WAA performs the analysis based on how long you tell it to perform each task in the mission. You also assign for each task workload values that reflect the amount of effort the crew member will have to expend to perform the task. During the simulation, WAA calculates how much workload each crew member was experiencing throughout the mission. In this way, you determine whether the crew members were overloaded and if so, how changes can be made.

WAA can use the minimum acceptable mission performance time that was developed using SPARC, another module of HARDMAN III, to compare to the WAA mission model. This will determine whether the mission met its performance requirements.

MMAA OVERVIEW

MMAA is concerned with your system's RAM requirements. You break your system design down into the major subsystems (e.g., engine, rotors); then each subsystem is broken into its components (e.g., solenoid, carburetor). You list these in MMAA and enter the maintenance parameters for each component. These include

- How often the component needs maintenance
- What type of maintenance is needed (troubleshoot, remove & replace, inspect, adjust & repair, test & check)
- What category of maintenance is needed (preventative or corrective)
- Who will do the maintenance
- How long the maintenance will take
- Whether the need for this maintenance will interrupt the current mission

You also enter the mission length and the time between missions. MMAA will execute the maintenance simulation model and will generate a report that includes the number of maintenance man-hours required and the resulting RAM of the system.

In this section, both WAA and MMAA are presented in detail. Before beginning the tutorial, be sure you have performed the activities for installing the software described in Section 2 of this User's Manual.

STARTING MAN-SEVAL

To begin using MAN-SEVAL, follow these steps:

1. If you have not already done so, turn on your computer and boot up your operating system.

2. At the C:> prompt, type: cd \MANSEVAL.

Note. If you installed MAN-SEVAL into a directory other than this one, substitute the correct directory name in the cd command.

3. Press the "Enter" key.

4. Type MANSEVAL.

5. Press the "Enter" key.

6. After the logo is displayed, press the "Enter" key.

7. Now you will see a screen that shows you the versions for each of your MAN-SEVAL modules. These versions are used to determine whether you have the most current MAN-SEVAL. To progress past this screen, press the "Enter" key.

The MAN-SEVAL main menu should now be displayed on your screen, as shown in Figure 1. The second menu item, "Begin work on a new system," lets you enter a new system and begin an analysis from scratch. Although you should not choose this option during this tutorial, we will discuss what would happen if you did.

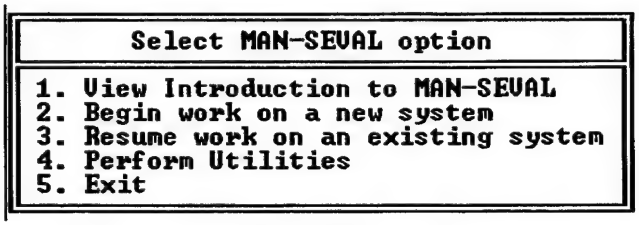


Figure 1. MAN-SEVAL main menu.

BEGIN WORK ON A NEW SYSTEM

If you were to choose this option from the MAN-SEVAL main menu, you would be asked to identify the mission area and system type of that system. If necessary, you could enter a new system type. After you did this, you would be asked to enter the name of your new system. Finally, if you wish, you could enter a version for your system. Examples of these entries are shown below:

Mission Area:	Aviation
System Type:	Attack Helicopter
System Name:	LH
System Version:	- X

If the system already exists in MAN-SEVAL, you will see a message that tells you this. You could then choose either to continue or to go back and enter a different system. If the system does not exist in MAN-SEVAL, you would be asked to identify a mission from the MAN-SEVAL library that is most like the mission you are trying to model. You could search through all the other systems to find a comparable mission. MAN-SEVAL uses this comparable

mission to set your defaults and to provide a starting place for your analysis. Finally, you would be asked to enter a mission name. Then, you would be ready to proceed through MAN-SEVAL.

RESUME WORK ON AN EXISTING SYSTEM

The third item on the menu, "Resume work on an existing system," lets you continue working on a system that already has some existing data entered in MAN-SEVAL. This is the menu item you will select to proceed through this tutorial since it is the quickest way to see all the steps in MAN-SEVAL. The fourth menu item is "Perform Utilities." This tutorial does not go through the utilities; they are discussed in detail in Section 7 of this user's manual.

To select "Resume work on an existing system,"

1. From the MAN-SEVAL main menu highlight "Resume work on an existing system."

2. Press the "Enter" key.

Now, you should see a screen that includes a long list of Army systems, as shown in Figure 2. This list has four columns that contain information about the system.

Existing Systems			
Mission Area	System Type	System Name	Version
Air Defense	HIMAD	Patriot	
	Man Portable Systems	Stinger	
	Mobile Gun Systems	Vulcan	
Aviation	Attack Helicopter	AH-64	
	Cargo Helicopter	CH-47D	
	Scout Helicopter	OH-58D	
	Utility Helicopter	UH-60	
Close Combat Heavy	Cavalry Fighting Vehic	M3A1	
	Tanks	M1A1	
Close Combat Light	Anti-Tank Vehicles	ITV	
	Anti-Tank Weapons	Dragon	
	Grenade Launchers	M-203	
	Infantry Fighting Vehi	M2A1	
	Machine Guns/Automatic	SAW	
	Man-Portable Indirect	81MM Mortar	
	Rifles	M-16	
▼ Select	Copy	Delete	Exit

Figure 2. "Existing Systems" menu.

Now, select the UH-60 system by following these steps:

1. Under system name, highlight "UH-60." (Notice that it is near the top of the list and is a utility helicopter.)

2. Press the "Enter" key.

Now, you should see a small menu that lists the two parts of MAN-SEVAL (see Figure 3): MMAA and WAA. Both of these parts are presented in this section, but first we will go through WAA.

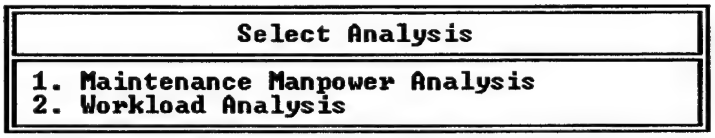


Figure 3. The two parts of MAN-SEVAL.

WORKLOAD ANALYSIS AID (WAA)

You will use WAA to specify the mission that the system is expected to accomplish. WAA contains large data libraries that you can access. These libraries contain missions for 21 different Army weapon systems, including helicopters, howitzers, tanks, rifles, and trucks. You can select one of these existing missions and modify it to fit your needs or define a new mission from scratch.

From the small menu select the WAA portion of MAN-SEVAL by following these steps:

1. Highlight "Workload Analysis."

2. Press the "Enter" key.

Now, you should see a menu (see Figure 4) that is very similar in format to the previous system list. In this case, the list of items in the center of the menu consists of the missions that already exist in WAA for the UH-60. Next, you will copy one of these missions into a mission of your own menus so that you can use it throughout the rest of this tutorial.

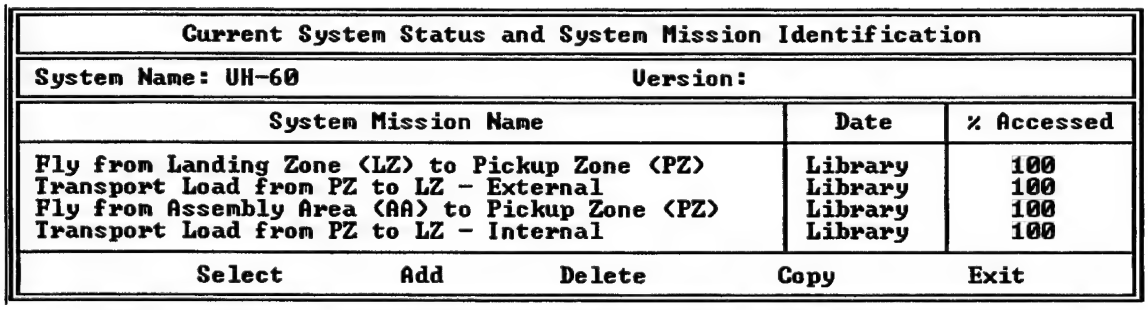


Figure 4. "Current System Status and System Mission Identification" menu.

Selecting a Mission From the Existing System

You will notice that in the mission list the center column contains either the date that the mission was entered or the word "Library." There are two types of data in MAN-SEVAL, library data and working file data. Library data came primarily from Army data sources and have been included in WAA to provide "baselines" from existing weapon systems. The library is "read only." This means that you cannot delete or change library data. You can review the data or you can copy library data to a working file and then make whatever changes you want for your analysis. The entries you make will be stored in the working files. You can change any working file data at any time, without restriction.

Now, copy the "Fly from Landing Zone (LZ) to Pickup Zone (PZ)" mission by following these steps:

1. Highlight "Fly from Landing Zone (LZ) to Pickup Zone (PZ)."

2. Highlight "Copy."

3. Press the "Enter" key.

WAA will now ask you to name your new mission (see Figure 5). First, you should look at the HELP screen so you can understand some rules for WAA mission names.

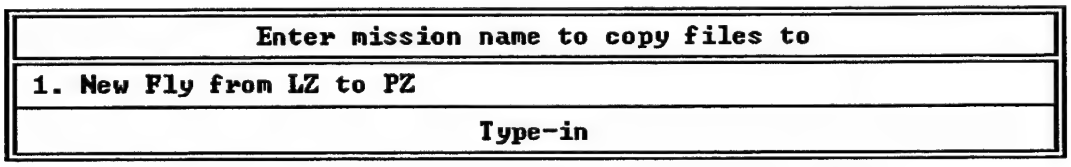


Figure 5. "Enter mission name to copy files to" screen.

To read the HELP screen and then enter the name of your new mission, follow these steps:

1. From the screen that prompts you to enter a new name, press the "F1" key and review the information from the HELP screen.

2. Return to the "Enter New Name" menu (press any key) and enter a new name for this mission (example: "New Fly from LZ to PZ").

3. Press the "Enter" key after you have entered the new name.

Now, your list of missions should have your new mission in it. To select this mission for the remainder of your work in this tutorial, follow these steps:

1. Highlight the name of your new mission.

2. Highlight the "Select" command.

3. Press the "Enter" key.

After you identify the mission you wish to analyze, WAA will present the main step menu (see Figure 6). This menu lists the steps necessary to describe the mission you have identified. In this tutorial, we go through each of these steps in detail. As we go through them, the accessed column on the WAA step menu will change to a date.

Workload Analysis Aid	Last Accessed
1. Define Conditions	Unaccessed
2. Mission Level Data	Unaccessed
3. Develop Function List	Unaccessed
4. Develop Task List	Unaccessed
5. Identify Crew Positions	Unaccessed
6. Assign Tasks to Jobs	Unaccessed
7. Define Performance Parameters	Unaccessed
8. Execute Simulation Run	Unaccessed
9. Analyze Simulation Results	Unaccessed
10. Display and Print Reports	Unaccessed
11. Exit	
Select	

Figure 6. WAA step menu.

Since you copied this mission from the library, data already exist for every step in WAA. For the remainder of this section, we will be reviewing these data.

Building Your Mission Model

Although the WAA steps are presented in order, you do not necessarily have to complete them in this order. In fact, if you are modifying an existing mission and all you want to do is change the task performance estimates, you can go directly to Step 7 and make your changes. However, if you are working on a new mission or one that is unfamiliar, you will want to go through the steps in the order listed.

Remember that if you have questions about any menu or screen, you can always get an explanation by pressing "F1" when you are looking at that screen. Also, if you want to cancel a selection you have made, press "Esc" to escape. The escape key will always erase or cancel the last thing you did. WAA will warn you in case you try to exit without saving a change you made.

Step 1: Define the conditions under which your mission will be performed. Regardless of how you got here, whether you are working on a new mission or modifying an existing one, you use this step to identify the environmental, terrain, threat or target and friendly force conditions that will affect your system as it is performing its mission. The values you set for these conditions do not affect the mission simulation model that WAA will run in Step 8, but they will be passed from MAN-SEVAL to PER-SEVAL, another HARDMAN III module, in which some of the conditions automatically affect the mission simulation.

However, the values that you set here should affect the performance estimates that you yourself make for each of the tasks in Step 7. As an example, if you have chosen environmental conditions that indicate this mission will take place at night, then for a task such as "Identify Target", you might enter a slower performance time and possibly a lower probability of being performed accurately.

We know that most missions are performed under a wide variety of conditions. We recommend that you begin by representing the most likely condition set and analyze your mission under these conditions. Then, we recommend that you identify the "worst case" condition set and repeat your analysis.

To begin working on a condition set, follow these steps:

1. From the WAA step menu, highlight option 1: "Define Conditions."

2. Press the "Enter" key.

Now you should see a screen with a list of condition sets, as shown in Figure 7. When you first enter this step, you can select a condition set from the list, add a new one, delete an existing one, or copy an existing one. Each condition set contains a set of assumptions about the mission, and many condition sets can be associated with each system.

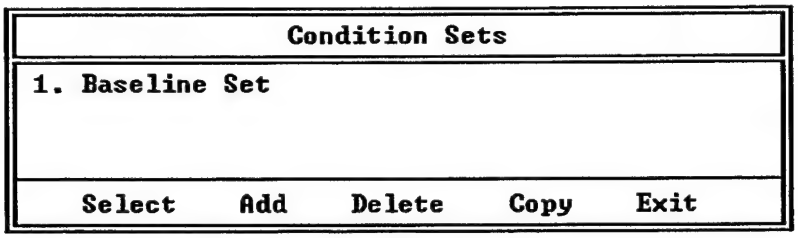


Figure 7. "Condition Sets" menu.

Select a Condition Set. To look at a condition set that is listed and perhaps change one or two selections, use the "Select" command.

To display the baseline condition set, follow these steps:

1. Highlight the "Baseline Set" condition set.
2. Highlight "Select."
3. Press the "Enter" key.

The next screen contains the four categories of conditions, as shown in Figure 8.

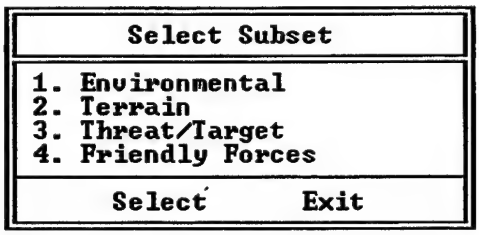


Figure 8. "Condition Subset" menu.

To view the first type, the environmental conditions, follow these steps:

1. From the "Condition Subset" menu, highlight option 1: "Environmental."
2. Press the "Enter" key.

Now you will see a screen that lets you enter and change the condition values, as shown in Figure 9. The condition is listed on the left-hand side of the screen (e.g., "Day/Night") and the current value of the condition is listed on the right-hand side of the screen (e.g., "Day"). You can move through this list using the vertical arrow keys. Notice that as you move through the list, the center command listed at the bottom of the screen changes between "Select," "Toggle," "Type in," and "Edit," depending on the type of entry that is most appropriate.

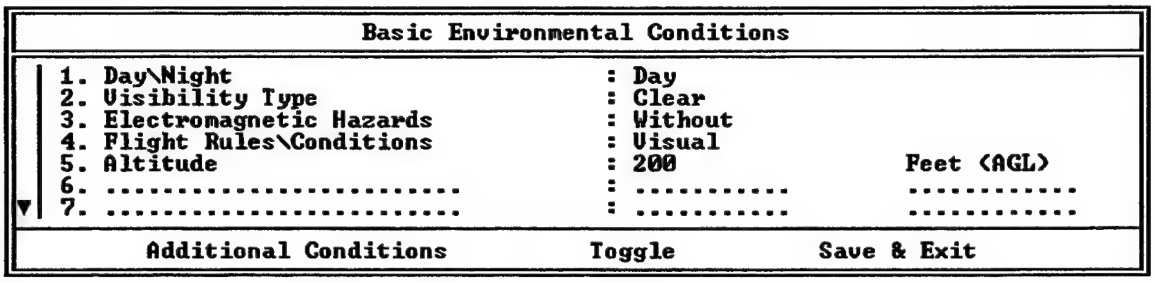


Figure 9. "Basic Environmental Conditions".

Changing Condition Values. To change an environmental condition,

1. Highlight the condition you want to change.

2. Highlight the command in the center of the command bar (e.g., "Select," "Toggle," "Type in" or "Edit").

3. Press the "Enter" key.

WAA will now prompt you to enter a new value. If you are in the "Type in" or "Edit" command, you will have to press "Enter" again to exit the command mode.

Adding New Conditions. Although the lists of conditions in WAA are extensive, they may not include every condition you will need to describe your mission. For this reason, the end of each list includes three conditions that are completely changeable. Usually, these conditions will appear as dotted lines.

To add a new condition to the environmental condition list:

1. Highlight one of the dotted lines.

2. Highlight "Edit."

3. Press the "Enter" key.

Now you will see a blinking cursor underneath the left side of the dotted line.

1. Type a new condition name (example: "Maximum Temperature").

2. Press the "Enter" key.

3. Type a value for your new condition (example: "110").

4. Press the "Enter" key.

5. If appropriate, type units for your new condition (example: "degrees F").

6. Press the "Enter" key.

You will also notice that the command bar at the bottom of the screen includes a command called "Additional." Use this command to change the more detailed conditions that are associated with each of the four categories.

When you are finished adding and changing the conditions that apply to this mission, follow these steps:

1. Highlight "Save & Exit" on the "Basic Environmental Conditions" screen.

2. Press the "Enter" key.

The "Condition Subsets" menu is displayed. We do not go through the other three types of conditions shown. Their screens are similar to the basic environmental conditions screen shown earlier. To return to the WAA step menu, follow these steps:

1. Highlight "Exit" on the "Condition Subsets" menu.

2. Press the "Enter" key.

3. Highlight "Exit" on the "Condition Set" menu.

4. Press the "Enter" key.

If you try to exit the step without saving the changes you have made, WAA will warn you and ask you whether that is what you really want to do.

Step 2: Mission level data. In this step, WAA allows you to enter data about the mission. To begin entering mission level data, follow these steps:

1. Highlight "Mission Level Data" on the WAA step menu.

2. Press the "Enter" key.

You will now see the "Mission Level Data" menu. From this menu you can change the time units with the "Select Units" command, change the time with the "Select Time" command,

and enter a description in the description field with the "Select Description" command. Now we will explain changing the time and changing the mission description. To change the time, follow these steps:

1. Highlight "Select Time."
2. Press the "Enter" key.
3. Enter the new time (example: 43).
4. Press the "Enter" key.

To change the mission description, follow these steps:

1. Highlight "Select Description."
2. Press the "Enter" key.
3. Type a mission description (example: "This mission is from the tutorial").
4. Press the "Enter" key.

Now you have completed entering mission level data. To save your work and proceed to the next step, do this:

1. Highlight "Save & Exit."
2. Press the "Enter" key.

You should now be back at the WAA step menu.

Step 3: Develop function list. In this step, WAA helps you break the mission down into its functions. Examples of functions are "Acquire Target," "Engage Target," and "Communicate." Also, WAA helps you identify maximum acceptable performance times for the mission and each function. Finally, it helps you link the functions together in a network that represents the mission. To get started in this process, follow these steps:

1. From the WAA step menu, highlight option 3: "Develop Function List."
2. Press the "Enter" key.

The first screen you should see, Figure 10, contains a list of the functions that are currently entered in the mission you have selected.

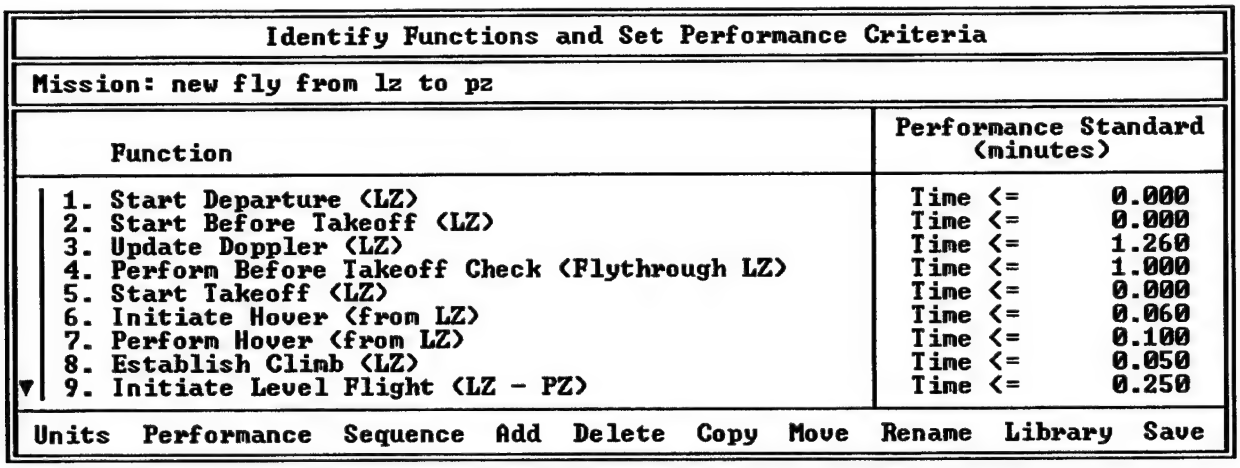


Figure 10. "Identify Functions and Set Performance Criteria" screen.

The commands at the bottom of the screen are used to

- change the time *units*
- change the maximum *performance* time allotted for the function
- *sequence* the functions within the mission
- *add* a function to the list
- *delete* a function from the list
- *copy* a function in the list
- *move* or reorder the functions in the list
- *rename* a function in the list
- copy a function from the *library* into this list
- *save* the function data

The second and third commands are discussed in the following paragraphs. All commands except the second and third are basically self-explanatory. If you have any questions about the details of how a particular command works, choose the command and then press "F1."

Changing the Maximum Allowable Mission Performance Time. You will use the "Performance" command to specify the maximum time in which the mission can be performed and still be considered a success. Ideally, this time will be automatically imported into WAA from SPARC using the utilities program. More details regarding how you would import these data are provided in Section 7 of this User's Manual.

You can also use the "Performance" command to modify or enter this value. During Step 8, when WAA executes your mission model, the performance time that is predicted by the aggregation of your individual tasks will be compared to this standard to ensure that your design can meet the requirements set during a previous SPARC analysis.

To change the maximum allowable mission performance time, follow these steps:

1. Highlight "Performance."

2. Highlight the function in the list to change its performance time (example: "Start Departure").

3. Press the "Enter" key.

4. At the flashing cursor (in the "Performance Standard" column), type a number to represent the maximum time in which this function can be performed and still be considered a success (example: "1.0").

5. Press the "Enter" key.

Sometimes it is convenient to use "dummy" functions to clarify the flow of your mission. These dummy functions will act as place holders in the function list and in the sequence, but if you do not assign tasks to the function, they will not take any time in the mission simulation model. For this reason, some of the functions in the library models have a performance time standard of 0 minutes.

Specifying the Function Sequence. You will use the "Sequence" command to build a network of your functions. This network controls the order in which each function is executed during your mission simulation. We recommend that you take a moment to sketch a flow diagram of your functions on a piece of paper before you begin this part of the function step. This diagram will make it easier for you to enter the information required by WAA on this screen.

Now, select the "Sequence" command.

1. Highlight "Sequence."

2. Press the "Enter" key.

You will notice that the screen displayed (see Figure 11) has the same list of functions as the previous screen (see Figure 10), but with other entries in the list ("START" and a function 99. "END") as well as different commands at the bottom. These are used to identify the function sequence.

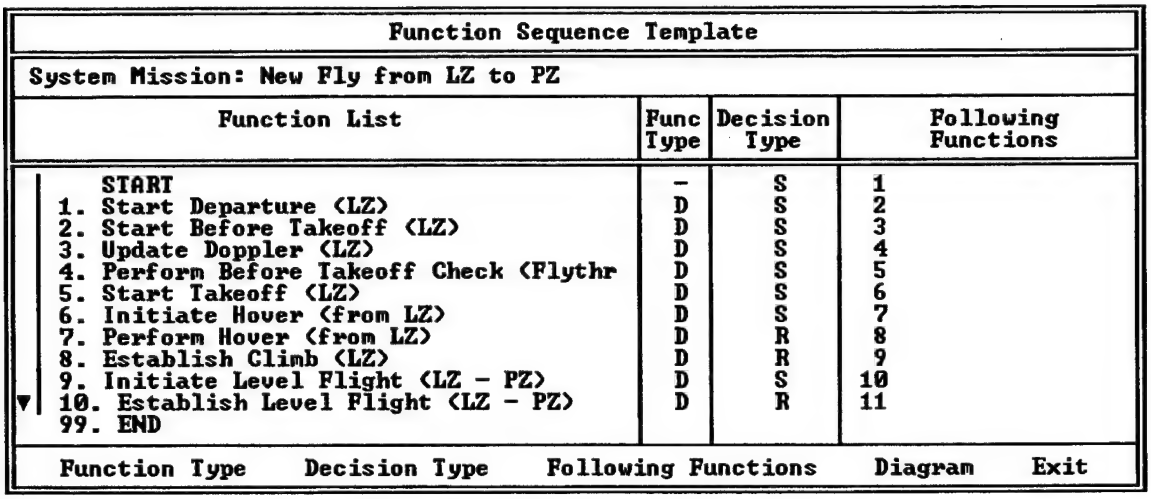


Figure 11. Function sequence template.

Function Type. The first command, "Function Type," helps you identify the type of each function in your mission. There are two possible function types: discrete and continuous, and these are described below.

- Continuous functions cycle on and off continuously throughout your entire mission. Examples of continuous functions are "Navigate," "Communicate," and "Adjust Internal Environment." Once you identify a function as continuous, WAA will prompt you to enter the cycle time for that function. This controls how often the function repeats itself.

- Discrete functions are functions that can be linked into your network diagram and will happen as soon as the function preceding them is completed. Examples of discrete functions are "Acquire Target," "Engage Target," and "Reload Weapon."

For more information about the difference between discrete and continuous functions, you can read the help screen describing the "Function Type" command. To do this, follow these steps:

1. Highlight "Function Type."

2. Highlight one of the listed functions (example: "Before Takeoff (LZ)").

3. Now with the function type screen displayed, press the "F1" key.

After you have read the help screen, follow these steps to continue with the next command:

1. Press the "Escape" key (or any key) to leave the help screen.

2. Press the "Escape" key to leave the function type screen.

Decision Type. You will use the "Decision Type" command at the bottom of this screen to identify a decision type for each of the functions in your network. The four possible decision types are as follow:

- Single - The same function always follows this one.

- Multiple - More than one function will begin as soon as this one is completed. All following functions will begin performing in parallel.

- Probabilistic - One of several functions may follow this one. Each potential following function has a probability of being selected. The sum of the probabilities must equal 1.0.

- Repeating - This function will repeat itself before going to its following function. You will be asked to enter the number of times it should repeat.

For more information about these decision types, you can read the help screen. To do this, follow these steps:

1. Highlight the "Decision Type" command.

2. Highlight a function that has a discrete function type (continuous functions do not have a decision type).

3. Press the "Enter" key.

4. With the "Decision Type" screen displayed, press "F1."

After you have finished reading the help screens, follow these steps:

1. Press the "Escape" key (or any key) to leave the help screen.

2. Press the "Escape" key to leave the "Decision Type" command.

Following Functions. The "Following Functions" command on the function sequencing screen (Figure 11) lets you identify the functions that follow one another. All functions must be assigned a following function. The last function in the sequence should be assigned #99 (END) as the following function to identify a convergent location in the sequence. When you add a function, #99 (END) is the default following function.

The screen where you enter this information depends on the decision type you select for the function. For instance, if you specify that a function has a single decision type, WAA will prompt you to enter the number of the single following function. If you specify that the function has a probabilistic decision type, WAA will prompt you to enter the numbers for all the potential following functions and the probabilities that they will be chosen.

If you specify a multiple decision type, WAA will prompt you to enter the numbers of all the functions that will begin when the specified function is completed. In addition, WAA will ask you where these multiple paths will rejoin. WAA requires that the paths come back together at a single point. This requirement ensures that the simulation model will wait for all the parallel functions to finish before it proceeds to the next function. An example of a multiple decision is shown in Figure 12.

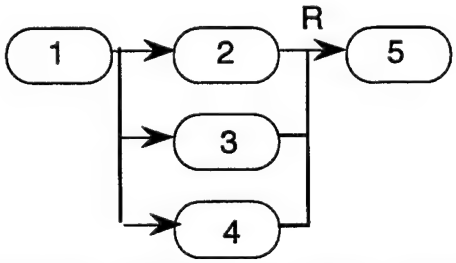


Figure 12. Example of a multiple decision.

In this example, Function 1 has a multiple decision. Its following functions are Functions 2, 3, and 4. All these paths rejoin at Function 5. Let us look at an example that is a bit more difficult, as shown in Figure 13.

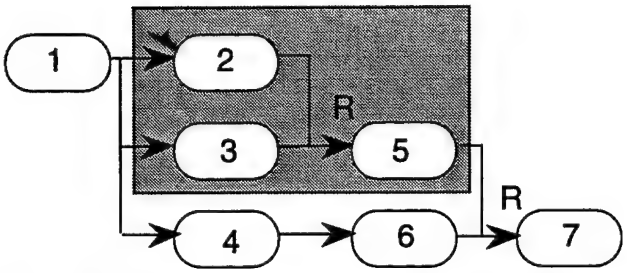


Figure 13. A multiple decision following a multiple decision.

In this example, Function 1 has a multiple decision. Its following functions are the same as before, 2, 3, and 4, but Functions 2 and 3 rejoin at 5, and this path does not rejoin the path through Function 4 until Function 7. In order for WAA to understand how to correctly manage this network, you will have to change it so that all parallel paths that branch from a single function rejoin at the same function. In other words, Functions 2 and 3 represent a "sub-branch" that must have its own beginning (Dummy 8) and end (rejoin at Function 5) before rejoining the "main" branch at Function 7. To create such a sub-branch, you would have to insert a "dummy" function as shown by Function 8 in Figure 14.

Dummy functions take no time to execute and have no effect on the performance of your model as long as you do not assign any tasks to the dummy function. (Assigning tasks is done in the next step, Step 5.) In effect, dummy functions are invisible to your mission. Their only purpose is to tell the computer how to execute the network.

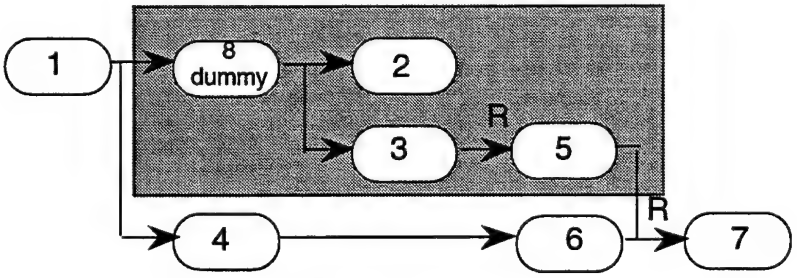


Figure 14. Use of dummy function.

Once the dummy function is inserted, Function 1 still has a multiple decision but now with two paths instead of three as before. It now goes to the new "dummy" Function 8 and to the original 4 and rejoins at 7. Function 8 (the dummy) also has a multiple decision. It goes to 2 and 3 and rejoins at 5. (This example is also described in the following function HELP screen.)

If you find that it is too difficult to know where the paths rejoin until after you have finished sequencing the rest of the functions in your mission, you can defer answering the rejoin question until you are able to view the network diagram in the next command. If you defer answering the rejoin question, you will be able to identify a rejoin point when you can look at the network drawing.

View the Network Drawing. To look at the network drawing, follow these steps:

1. From the "Function Sequencing Template" screen, highlight "Diagram."

2. Press the "Enter" key.

This command draws a diagram of the sequence you have entered. Use this diagram to check whether you have made any mistakes. At the bottom of this diagram is a "control panel" of commands that you can use to zoom in and out of the diagram, to move around and look at different parts of the diagram, or to print the diagram.

To show your entire mission on the screen, follow this step:

1. Press the "l" key.

The "l" command shows the complete "layout" of your sequence diagram. The diagram will be scaled to fit a single screen. Because this means each node in your diagram could be quite small, the names of the functions are not displayed. Notice the dotted box that is shown in your layout. This box shows the portion of the network that will be displayed if you return to a "close up" view. You can move the dotted box with the arrow keys.

To return to the "close up" view of your diagram, follow this step:

1. Press the "c" key.

If your complete sequence diagram does not fit on the screen, you can use the arrow keys to move to different portions of the display. As usual, you can use the "F1" key for further instructions of how each command works.

You should notice that any continuous functions will be listed down the left-hand side of your sequence diagram. These functions will not have any paths to them. All other functions must have paths to them. If you have a discrete function without a path to it, WAA will tell you this and will help you correct your mistake.

To leave this diagram and return to your sequence screen, follow this step:

1. Press the "ESC" key.

Entering the sequence of functions within your mission is the last part of Step 2. After you have completed this step, you will have identified the functions in your mission, and you will have linked them together into a network. Now, to save any data and return to the WAA step menu, follow these steps:

1. From the "Function Sequence Template" screen, highlight "Exit."
2. Press the "Enter" key.
3. From the function criteria screen (Figure 10), highlight "Save"
4. Press the "Enter" key.

Step 4: Develop task list. The purpose of this step is to help you break down each function you entered in Step 3 into its tasks. This step is very similar to the previous step with a couple of additions: the "Function" command and the "Decompose" command. To begin Step 4, follow these steps:

1. From the WAA step menu, highlight option 4: "Develop Task List."
2. Press the "Enter" key.

Now you will see a lists of tasks from the first function in your mission (see Figure 15). At the bottom of the screen you will see the "Function" command. You can use this command to choose the next function that you want to work on in this step.

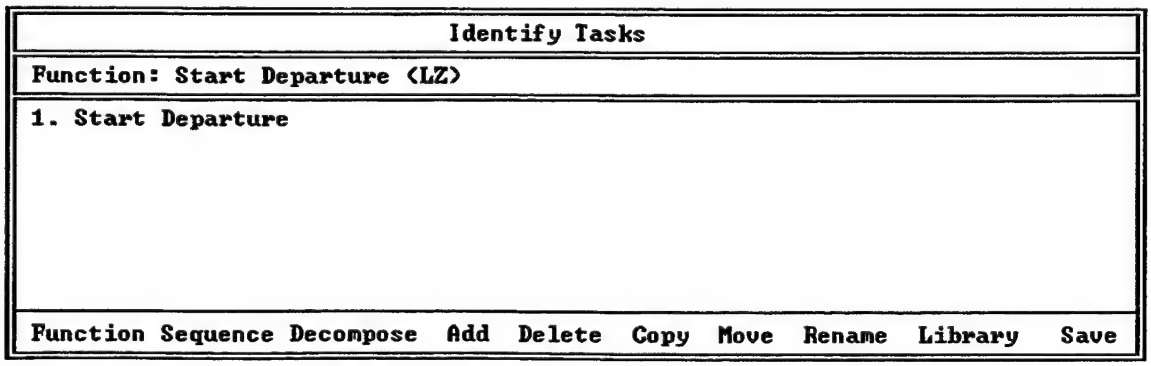


Figure 15. Identify tasks.

Changing Functions. Follow these steps to use the "Function" command:

1. Highlight "Function."

2. Press the "Enter" key.

A list of the functions in your mission is displayed, as shown in Figure 16.

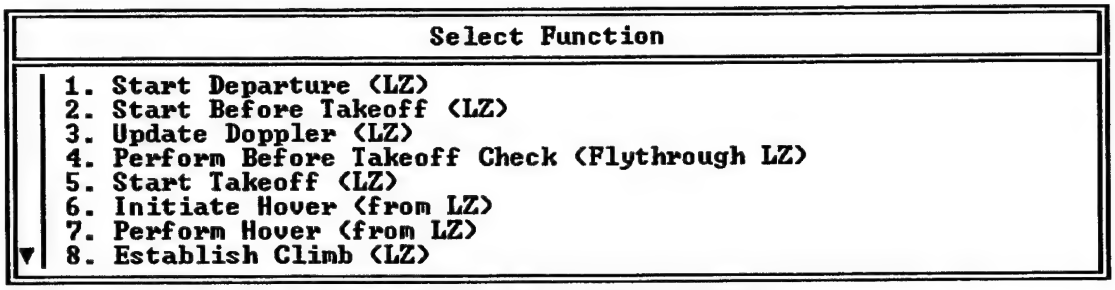


Figure 16. List of mission functions.

To select another function from the list, follow these steps:

1. Highlight the one you want to work on (example: "Update Doppler").

2. Press the "Enter" key.

The list of tasks from the function you just chose will be listed on your task screen, as shown in Figure 17. Now you can work on these tasks with the commands at the bottom of the screen.

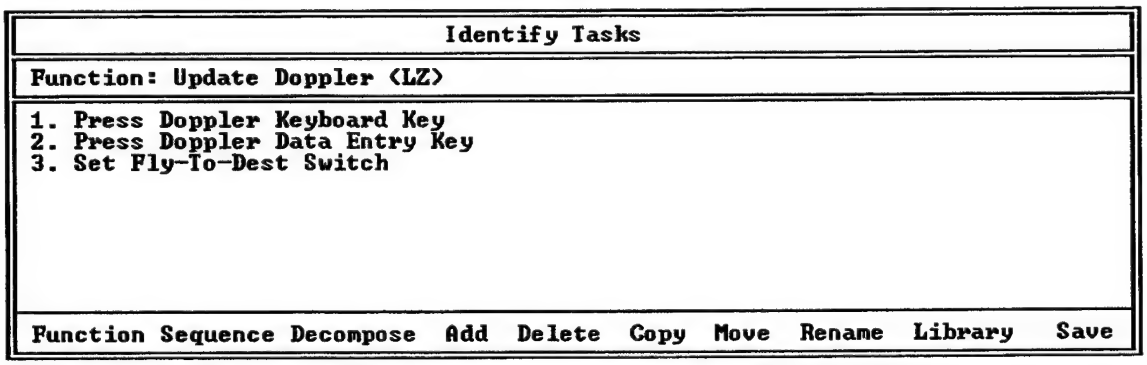


Figure 17. List of tasks in the function "update Doppler."

Decomposing a Task into Smaller Tasks. You use the "Decompose" command to break a task in your list into several tasks. You would do this if you think that the task might be

performed by two different crew members at once or if you feel the task is too general and you want to make it more specific by subdividing it into smaller pieces.

Follow these steps to use the "Decompose" command:

1. Highlight "Decompose."

2. Highlight a task you want to subdivide into smaller pieces (example: "Press Doppler Keyboard Key").

3. Press the "Enter" key.

Now, you should see a screen (see Figure 18) that you will use to add the new tasks that will replace the one you have highlighted.

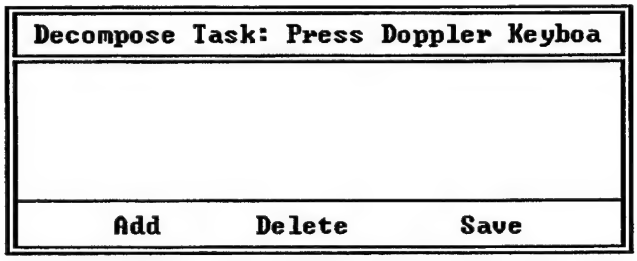


Figure 18. "Decompose Task" screen.

To add the new tasks, follow these steps:

1. Highlight "Add."

2. Press the "Enter" key.

3. Type the first new task name (example: "Locate Doppler Keyboard Key").

4. Press the "Enter" key.

5. Continue adding tasks to the list of tasks, until you have entered all the new ones (another example: "Press Doppler Keyboard Key").

6. Highlight "Save."

7. Press the "Enter" key.

Sequencing the Tasks. The sequencing of tasks is done in the same way we explained sequencing functions in Step 3 but with one exception. There are no "task types" since all tasks are discrete. If you have tasks that cycle on and off throughout the mission like the continuous functions do, then you should make them functions.

To sequence the tasks in the function, follow these steps:

1. Highlight the "Sequence" command

2. Press the "Enter" key.

The "Task Sequence Template" is displayed in Figure 19. The commands along the bottom of the screen are used in the same way as described when sequencing functions. You can also get information from the appropriate help screen.

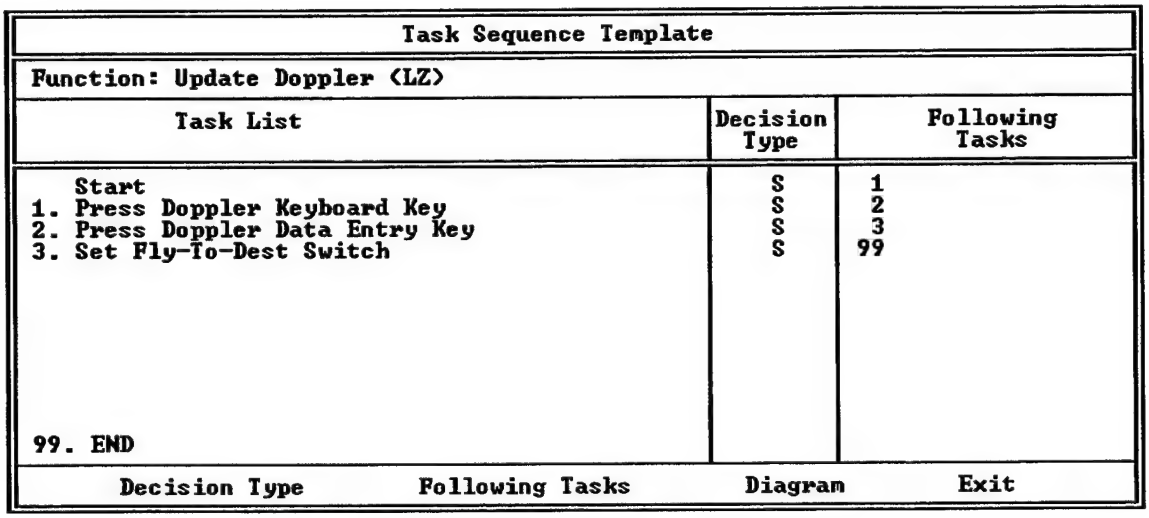


Figure 19. "Task Sequence Template" screen.

Now you have completed the WAA step of developing the task list. Follow these steps to return to the WAA step menu:

1. From the "Task Sequence Template," highlight "Exit."

2. Press the "Enter" key.

3. From the "Identify Tasks" screen, highlight "Save."

4. Press the "Enter" key.

Step 5: Identify crew positions. In this step, you identify the crew members (maximum ten positions) that will operate your system during this mission. To do this, follow these steps:

1. From the WAA step menu, highlight option 5: "Identify Crew Positions."

2. Press the "Enter" key.

The first screen you see, Figure 20, lists the crew members that have already been identified for this system. You should be familiar with the first two commands on the bottom of the screen ("Add" and "Delete") so we just discuss the other commands.

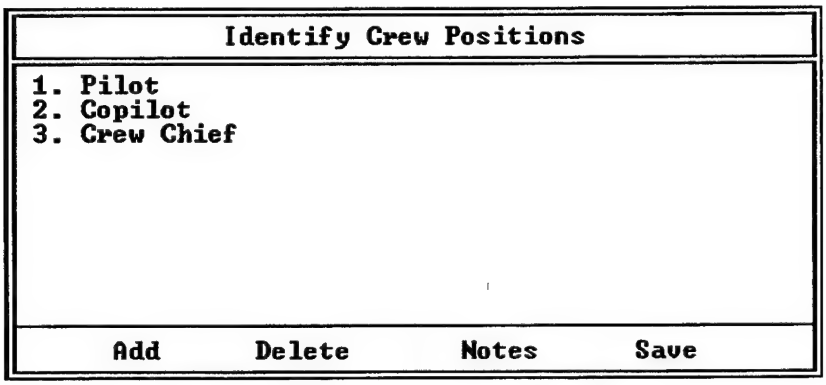


Figure 20. "Identify Crew Positions" menu.

Documenting Your Assumptions About the Crew Members. You can use the "Notes" command to enter notes to yourself and anyone who will look at this mission later. To enter a note about a crew member, follow these steps:

1. Highlight "Notes."

2. Highlight a crew member (example: "Pilot").

3. Press the "Enter" key.

Now, a job notecard will display, as shown in Figure 21. There are separate lines on this notecard for you to enter the job title for the crew member you have highlighted, the crew member's MOS, skill level, and any other comments you have. This information is optional and for documentation purposes only. It will not affect the performance of the model.

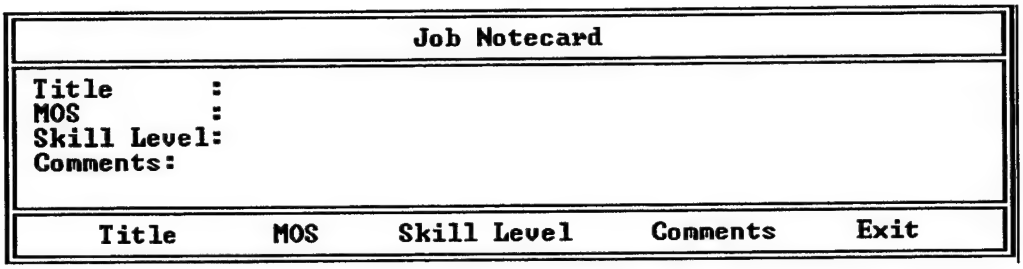


Figure 21. "Job Notecard" screen.

To enter a comment on the notecard:

1. Highlight the command on the bottom of the screen in which you would like to enter a comment.

2. Press the "Enter" key.

3. At the flashing cursor, type the comment.

4. Press the "Enter" key.

To return to the "Identify Crew Positions" screen, follow these steps:

1. Highlight "Exit" on the notecard.

2. Press the "Enter" key.

Now, you have reviewed the crew members who will perform the tasks in this mission. To return to the WAA step menu:

1. Highlight "Save."

2. Press the "Enter" key.

Step 6: Assign Tasks to Jobs. In this step, you will assign the crew members identified in Step 5 to the tasks you entered in Step 4. To begin this step, follow these steps:

1. From the WAA step menu, highlight option 6: "Assign Tasks to Jobs."

2. Press the "Enter" key.

The screen displayed (see Figure 22) should have the tasks for the first function in your mission listed down the left-hand column. The remaining columns have crew member names at the top of them with the title "Does crew member have access?"

Define Accessibility	Function: Start Departure (LZ)				
Tasks	Does crew member have access? Pilot	Copilot	Crew Chie		
1. Start Departure	Y				
Edit	Next Function	Select Function		Save	

Figure 22. Identifying crew member's accessibility.

This step has two parts: "Define Accessibility" and "Define Task Assignments". First, you will identify all the crew members from your list who have access to the controls and displays that will be necessary to perform each of the tasks. WAA will use this information to determine who a task should be reallocated to if the operator it has been assigned to is overloaded. Although the reallocation will not be performed until Step 9 when you are analyzing the results of the mission model simulation, WAA will need the accessibility information to ensure that all tasks that are reallocated have been assigned to crew members who can reach and see the controls and displays required to perform the task.

The second thing you will do is identify the crew member who will perform each task. WAA will only allow you to assign operators to tasks when you have already indicated that this operator has access to those tasks. (If you have a task that will be performed by more than one operator at once, you should split it into multiple tasks that are performed in parallel. You can make this change by returning to Step 4 and first using the "Decompose" command to create two tasks of one and then reworking the branching logic to make the tasks parallel.)

Identifying Which Crew Members have Access to each Task. Follow these steps to begin identifying which crew members have access to each task:

1. Highlight "Edit."

2. Press the "Enter" key.

3. Using the horizontal arrow keys to move the cursor between crew members, press the "Space Bar" to enter a "Y" in the column under each crew member who can reach and see the controls and displays that are necessary to perform the highlighted task.

Note. Although a maximum of five crew members can be shown on this screen at once, the horizontal arrow keys will show more of the screen, to a maximum of 10 crew members.

4. When you are finished, press the "Enter" key.

You must assign accessibility for all the tasks in each of the functions in your mission. Follow these steps to display the tasks for the next function in your mission:

1. Highlight "Next Function."

2. Press the "Enter" key.

The "Select Function" command will enable you to select a particular function from the list that you entered for your mission.

Note that the accessibility question can apply to training. For instance, the loader in a tank might be able to reach and see the automated target acquisition system controls and displays, but if he is not trained to use them, he still could not perform the tasks that need them. In other words, he would not have "mental access" to knowledge about the controls and displays. So when you assign accessibility, we recommend that you consider the training each crew member is likely to have, as well.

After you have provided the accessibility information for every function, save your entries and proceed to the next part of this step.

1. Highlight "Save."

2. Press the "Enter" key.

You may now get a message that says that you have a crew member, "Crew Chief," who has not been given access to any tasks. This is a warning message to alert you that you may have forgotten something. In our example, we will leave the "Crew Chief" task data as they are. Follow these steps to proceed past the warning messages:

1. Press the "Enter" key.

2. Press the "Y" key to proceed past the "error detected - okay to save" message.

Identifying Which Crew Member will Perform each Task. The next screen you should see (Figure 23) is very similar to the previous one, except the title over the crew member names is "Who is the task assigned to?" All the commands work as they did on the previous screen, except the "Edit" command only allows you to mark one crew member for each task. WAA will not allow you to mark a crew member who has not been identified as having access to the task (previous instructions).

Assign Tasks to Jobs	Function: Start Departure (LZ)				
Tasks	Who is task assigned to? Pilot	Copilot	Crew Chie		
1. Start Departure	X				
Edit	Next Function	Select Function		Save	

Figure 23. Assigning crew members to tasks.

To identify which crew member is assigned to each task, follow these steps:

1. Highlight "Edit."

2. Press the "Enter" key.

3. Using the horizontal arrow keys to move the cursor between crew members, press the "Space Bar" to enter an "x" in the column under the crew member who is most likely to perform the highlighted task.

4. When you have finished assigning tasks, press the "Enter" key.

This completes Step 6. Follow these steps to return to the WAA step menu:

1. Highlight "Save."

2. Press the "Enter" key.

At this point, you will get another warning message that the crew chief has not been assigned any tasks. The purpose of this message is to alert you that you may have inadvertently

omitted a crew member. For this tutorial, you can ignore this message, so follow these steps to proceed:

1. Press the "Enter" key.

2. Press the "Y" key to proceed past the second warning message.

Step 7: Define performance parameters. This step consists of four substeps:

- Substep 1 - Estimate Task Times - In this substep, WAA will help you estimate performance times for each of the tasks in your mission.

- Substep 2 - Estimate Workload - In the second substep, you will estimate the amount of workload that each task is likely to inflict on the crew member.

- Substep 3 - Define Overall Workload Measure - The third substep is optional. In this substep, you will have the opportunity to define a new workload channel that combines the WAA channels into an "overall workload measure".

- Substep 4 - Establish High Workload Definitions - Finally, you will use WAA to identify the workload thresholds for your crew members.

If you copied tasks from other missions in the library, all the performance parameters associated with those tasks will have been copied as well. This means that these tasks should have some of the performance parameters associated with them. Unfortunately, most of the missions in the original WAA library do not have workload values associated with them because these data were not available. Therefore, even when you copy tasks from library missions, you may have to enter the workload data.

To select this step from the WAA step menu,

1. Highlight "Define Performance Parameters."

2. Press the "Enter" key.

Now you will see a small screen that lists each of the four substeps, as shown in Figure 24. We recommend that you perform each substep in the order listed, although you can actually do them in any order you want. Also, if you are not very familiar with how the tasks in your mission will be performed, you may want to ask the advice of someone who has experience in

tasks similar to yours or on systems similar to yours. Many of the data items in this step can be difficult to estimate if you do not understand the tasks very well.

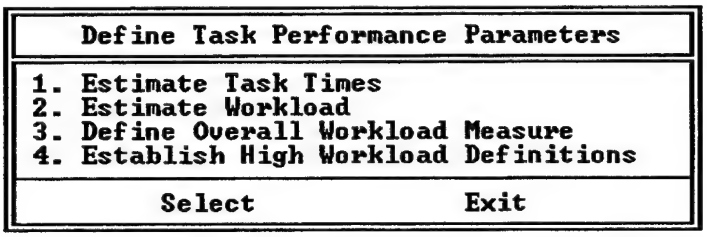


Figure 24. "Define Tasks Performance Parameters" menu.

Estimating Task Performance Times. To begin estimating task times:

1. From the "Define Task Performance Parameters" menu, highlight option 1: "Estimate Task Times."

2. Highlight "Select."

3. Press the "Enter" key.

Now, WAA will display the task performance time screen, as shown in Figure 25. On this screen, you will enter your best estimates for how the task will be performed in real life. Notice that this screen enables you to enter "most likely" and "fastest" estimates for the performance time. This capability is included because an action is almost never performed in exactly the same time in each occurrence. This facility allows you to take this into account.

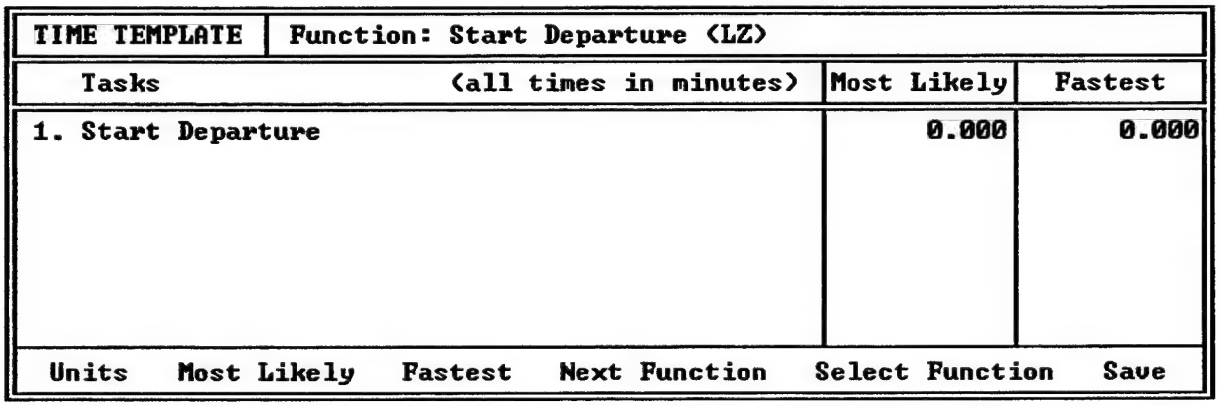


Figure 25. Estimate tasks times.

MAN-SEVAL will assume that the performance of a task follows a normal distribution with the time you enter for "most likely" assumed to be the mean and the time you enter as "fastest" assumed to be three standard deviations faster than the mean. Each time the task is executed in your model, a value will be drawn from this distribution to generate a specific time value for each occurrence.

Follow these steps to enter a performance time estimate:

1. Highlight the task you want to change (example: "Start Departure").

2. Highlight "Most Likely."

3. Press the "Enter" key.

4. Type a new value that represents the most likely performance time for the highlighted task (example: ".5").

5. Press the "Enter" key.

At this point, a prompt is displayed that asks whether you would like to retain the original relationship between the most likely and fastest performance times. If you answer "Y," MANSEVAL will automatically recalculate a fastest time so that the original standard deviation between the two values remains constant. If you answer "n," the fastest time will not be modified. To continue,

1. Enter "n" to the automatic update prompt.

2. Press the "Enter" key.

3. Highlight "Fastest"

4. Press the "Enter" key.

5. Type a new value that represents the fastest performance time for the highlighted task (example: "0.0").

6 Press the "Enter" key.

Use the "Next Function" and "Select Function" commands to enter performance times for all the tasks in all the functions of your mission. To return to the "Define Task Performance Parameters" menu, follow these steps:

1. Highlight "Save."

2. Press the "Enter" key.

Estimating Task Workload. The second substep is "Estimate Workload." The workload theory that we have implemented in WAA is discussed in detail in McCracken and Aldrich (1984). We discuss the basics of that report here, but if you want to learn more about this theory we recommend you consult that technical report.

Workload theory is based on the idea that every task a human performs requires some work. Usually, a task is composed of several different types of work. As an example, consider a task like steering your car. This task will have some visual work (watch where you are going), some cognitive work (decide if you are steering enough), and some psychomotor work (rotate the steering wheel). The workload theory in WAA helps you assign values representing the amount of effort that must be expended in each channel to perform the task. To help you, WAA displays a list of scale values and descriptors for each channel. These scales, shown below, are taken directly from Bierbaum, Szabo, and Aldrich (1989).

Scale Value	Visual Scale Descriptor
0.0	No Visual Activity
1.0	Visually Register/Detect (detect occurrence of image)
3.7	Visually Discriminate (detect visual differences)
4.0	Visually Inspect/Check (discrete inspection/static condition)
5.0	Visually Locate/Align (selective orientation)
5.4	Visually Track/Follow (maintain orientation)
5.9	Visually Read (symbol)
7.0	Visually Scan/Search/Monitor (continuous/serial inspection, multiple conditions)

Scale Value	Cognitive Scale Descriptor
0.0	No Cognitive Activity
1.0	Automatic (simple association)
1.2	Alternative Selection
3.7	Sign/Signal Recognition
4.6	Evaluation/Judgment (consider single aspect)
5.3	Encoding/Decoding, Recall
6.8	Evaluation/Judgment (consider several aspects)
7.0	Estimation, Calculation, Conversion

Scale Value	Auditory Scale Descriptor
0.0	No Auditory Activity
1.0	Detect/register sound (detect occurrence of sound)
2.0	Orient to Sound (general orientation/attention)
4.2	Orient to Sound (selective orientation/attention)
4.3	Verify Auditory Feedback (detect occurrence of anticipated sound)
4.9	Interpret Semantic Content (speech)
6.6	Discriminate Sound Characteristics (detect auditory differences)
7.0	Interpret Sound Patterns (pulse rates, etc.)

Scale Value	Psychomotor Scale Descriptor
0.0	No Psychomotor Activity
1.0	Speech
2.2	Discrete Actuation (button, toggle, trigger)
2.6	Continuous Adjustive (flight control, sensor control)
4.6	Manipulative
5.8	Discrete Adjustive (rotary, vertical thumbwheel, lever position)
6.5	Symbolic Production (writing)
7.0	Serial Discrete Manipulation (keyboard entries)

If you are not sure precisely how to rate a task, we recommend that you rate the task too high rather than too low. As you will see in Step 9, WAA will show you the workload peaks as the mission progresses. If, at that time, you see that one of your "questionable" ratings has led to a peak, you can investigate the task further to determine whether it is likely to lead to a problem in the "real world."

This theory also hypothesizes that if you are doing two tasks at once, the workload levels are additive within channels, across tasks. For example, if you are doing two tasks at once, one with a psychomotor load of 2.6 and one with a psychomotor load of 4.6, then WAA would record a psychomotor score of 2.6 + 4.6 = 7.2 for the time that the two tasks were being performed together. The value of each workload channel throughout the mission will be displayed in a graph in Step 9. From this graph, you will be able to see the times during your mission that the workload "peaked." In addition, the graph will tell you what each operator was doing during these peaks so you can pinpoint the tasks that contributed to high workload for each operator.

To begin identifying workload levels, follow these steps:

1. From the "Define Task Performance Parameters" menu, highlight option 2: "Estimate Workload."

2. Press the "Enter" key.

Now, you should see a screen that is similar to the performance time estimation screen (see Figure 26) except that it has four columns on the right side of the screen. These columns correspond to the four workload channels (visual, cognitive, auditory, and psychomotor) in which you can assign workload levels for each task.

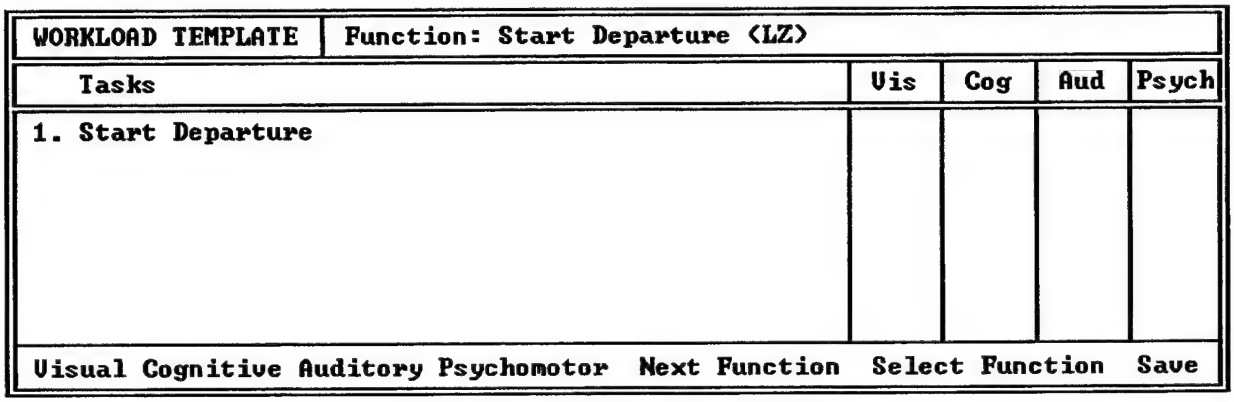


Figure 26. Estimate task workload.

To assign workload values to tasks, follow these steps:

1. Highlight a task in the list (example: "Start Departure").

2. Highlight the workload channel command at the bottom of the screen (example: "Visual").

3. Press the "Enter" key.

Now a screen is displayed which shows the scale values and descriptors for the workload channel you selected (see Figure 27).

To continue,

1. Use the vertical arrow keys to highlight the scale value that best describes the amount of visual work that is necessary to perform the highlighted task (example: 4.0 Visually Inspect or Check [discrete inspection or static condition]).

2. Press the "Enter" key.

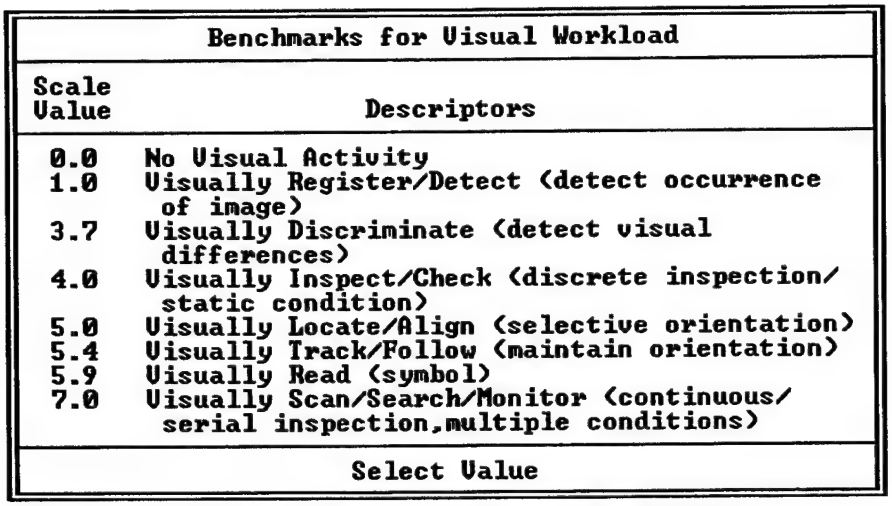


Figure 27. Visual scale values and descriptors.

The workload scale value you selected will be displayed on the screen. Repeat this process for the remaining channels for each task.

After you have assigned workload ratings for each task in your mission, return to the "Define Task Performance Parameters" menu. To do this, follow these steps:

1. Highlight "Save."

2. Press the "Enter" key.

Defining an Overall Workload Measure. This optional substep allows you to define an overall workload measure. In essence, it is used to combine the four workload channels into a single combined channel. For example, if you think that cognitive workload is twice as important as visual, psychomotor, and auditory in its contribution toward the total work an operator might feel, then you might be interested in tracking the value of an "overall" channel that weights each of the existing channels to represent your hypothesis. Your "overall" channel could be computed as follows:

$$O = 4 * C + V + P + A$$

in which

O = Overall
C = Cognitive
V = Visual
P = Psychomotor
A = Auditory

In Step 9, where the results of the workload in each channel are reported, the report will include values for "O" as the mission timeline progresses.

The screens that help you develop this equation are fairly complex, so we will go through them in detail. To begin this substep, follow these steps:

1. From the "Define Task Performance Parameters" menu, highlight option 3: "Define Overall Workload Measure."

2. Press the "Enter" key.

You will now see a small screen that is titled "Overall Workload Equation," as shown in Figure 28. No equation is shown since it still must be defined.

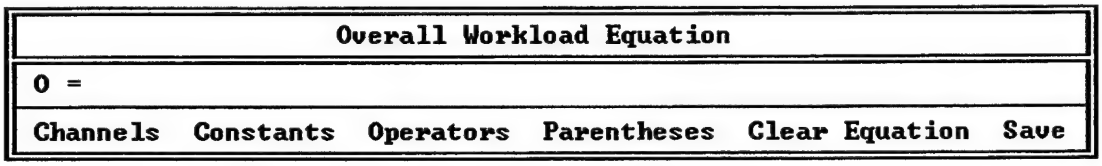


Figure 28. "Overall Workload Equation" screen.

This screen has six commands:

- Channels - Use this command to identify one or more channels that you want to include in your overall measure. In addition to auditory, cognitive, psychomotor, and visual, you can also use the "Number of Ongoing Tasks" in your equation.

- Constants - Use this command to change the constant numerical values in your equation.

- Operators - Use this command to change the mathematical operators in your equation. Valid operators include addition (+), subtraction (-), multiplication (*), and division (/).

- Parentheses - Use this command to position parentheses in your equation to control the order in which the equation is evaluated. If you do not use parentheses, the equation is evaluated from left to right, except that multiplication and division will be performed before addition and subtraction.

• Clear Equation - Use this command to clear the equation that is in the center portion of the screen and begin again with a blank screen.

• Save - Saves your equation and returns you to the "Define Task Performance Parameters" screen.

Now, if you want to build an equation for overall workload that is the sum of all the workload channels, then you would follow these steps:

1. Highlight "Channels"
2. Press the "Enter" key.

Now the "Select Channels" screen appears (see Figure 29).

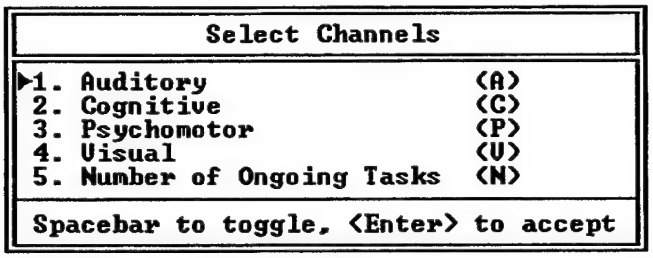


Figure 29. "Select Channels" menu.

To continue,

1. Highlight the first channel you want to include (example: Cognitive).
2. Press the "space bar."
3. Press the "Enter" key.

Notice that your overall equation displays as

$$O = 1 * C$$

Now, follow the previous steps to add the psychomotor, visual, and auditory channels to the equation. Notice that you can do this by using the space bar to mark all three channels. After you have done this, your equation should be:

$$O = 1 * C + 1 * P + 1 * V + 1 * A$$

This equation sums all the workload channels. Suppose you decide that you want to weight the cognitive channel by twice as much as the others in your equation. To do this, follow these steps:

1. From the "Overall Workload Equation" screen, highlight "Constants."

2. Press the "Enter" key.

3. Use the horizontal arrow keys to position the blinking cursor under the constant you want to change (example: the first "1" before "* C").

4. Press the "Enter" key.

5. Now, a small box will display in which you can change the "1" to a "2."

6. Press the "Enter" key.

After you have done this, your equation should be as shown in Figure 30. This has been a quick discussion of how to enter an overall workload equation. If you have further questions, press the "F1" key to get additional explanations about how the commands are used.

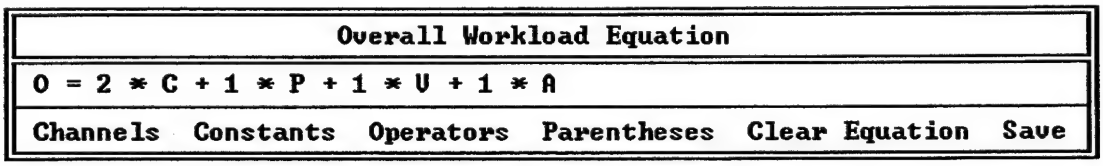


Figure 30. Example of overall workload equation.

When you have completed the overall workload equation, follow these steps to save your work and return to the "Define Task Performance Parameters" menu:

1. Highlight "Save."

2. Press the "Enter" key.

Establishing High Workload Definitions. High workload definitions are used to identify high workload levels for crew members. When your WAA mission model runs, the current workload levels of each operator are added across all tasks that the operator is performing. The sum is compared to each of the high workload definitions. If the current workload meets or exceeds any of the definitions, that segment of the mission is marked as "high workload." Later in Step 9, you will be able to recall and study each point of "high workload."

You define high workload in terms of the individual workload channels (V = visual, A = auditory, C = cognitive, P = psychomotor), the overall channel (O), and the number of ongoing tasks for each operator (N). You can combine any or all these terms in your definitions. For instance, if you want to define high workload as any time any operator is trying to perform more than two tasks at once, your definition would be "N>2." If you want to define high workload as any time auditory is more than 4 at the same time that cognitive is more than 4, your definition would be "A>4 & C>4."

To enter the high workload definitions, follow these steps:

1. From the "Define Task Performance Parameters" menu, highlight option 4: "Establish High Workload Definitions."

2. Press the "Enter" key.

WAA will display a new screen entitled "High Workload Definitions," as shown in Figure 31.

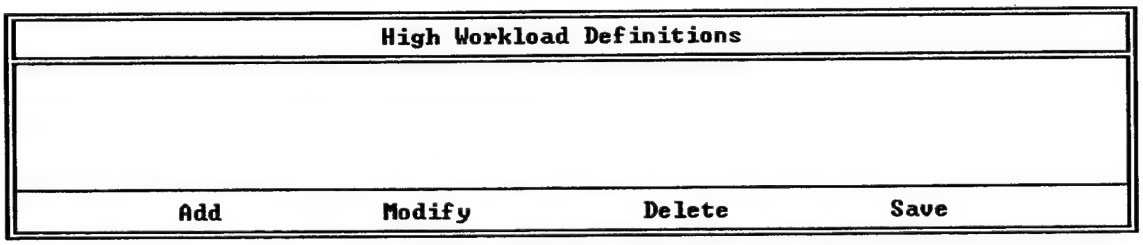


Figure 31. "High Workload Definitions" screen.

Follow these steps to enter a new definition:

1. Highlight "Add."

2. Press the "Enter" key.

Now, you will see a screen (see Figure 32) from which you can select the channels you want to include in your definition of high workload.

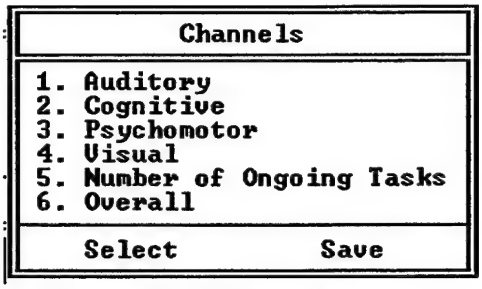


Figure 32. "Channels" menu.

Follow these steps to select a channel from the list:

1. Highlight the channel to define its high workload definition (example: "Auditory").
2. Press the "Enter" key.

After you select a channel from the list, WAA will prompt you to enter a numerical value that corresponds to the threshold for that channel. Now, enter a threshold value for the channel.

1. Type a "4" to represent the workload threshold in that channel.
2. Press the "Enter" key. Your high workload definition will now read "A>4.0."
3. Next, highlight the "Cognitive" channel.
4. Press the "Enter" key.
5. Type in "4."
6. Press the "Enter" key.

Your definition will now read "A>4.0 & C>4.0," as shown in Figure 33. You can continue selecting as many channels as you like for each definition.

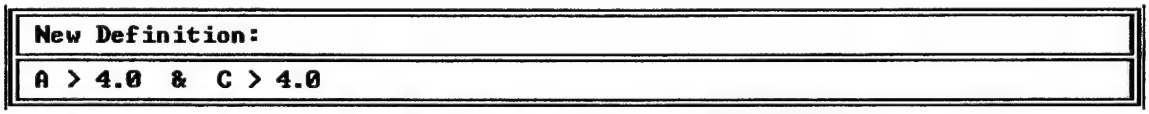


Figure 33. Example of high workload definition.

When you are finished, follow these steps to exit the "High Workload Definition" screen.

1. Highlight "Save."
2. Press the "Enter" key.

Since you have completed all the substeps in Step 7, follow these steps to exit to the WAA step menu:

1. Highlight "Exit" to exit to the "Define Task Performance Parameters" menu.

2. Press the "Enter" key.

Now you have finished building a model of your system's mission. Congratulations! Now it is time to execute it and look at the results.

Step 8: Execute. This step is somewhat simple, compared to the previous ones where you have had to input and define quite a bit of information. Its purpose is to start the simulation of the model you created. This is almost automatic, but you must enter some information . To begin this step, follow these steps:

1. From the WAA Step menu, highlight option 8: "Execute Simulation Run."

2. Press the "Enter" key.

The first screen you see in this step (see Figure 34) provides you the option of executing the simulation model in normal mode or animated mode. If you select the "Normal Execution," the model will run "silently," meaning that you will only see a status screen that gives you an estimate of the model's progress as it runs. The advantage of the normal mode is that the model will run very quickly. We recommend that you use the normal mode when you are certain that your mission is sequenced correctly and you are running the model to collect data.

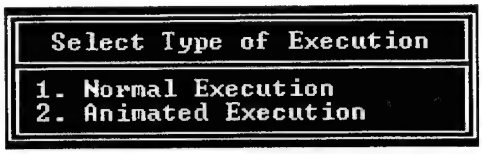


Figure 34. "Select Type of Execution" menu.

The second option on the menu you see is "Animated Execution." If you select this option, you will see a diagram of your mission model as the model executes. The nodes in the diagram will highlight to show the progression as the model runs. The advantage of the animated mode is that you can monitor the model as it runs and then use this to verify that the sequencing of the functions and subfunctions is correct. The disadvantage of the animated mode is that the model will run a bit slower because it is displaying so much information.

To see how to best employ the animated execution, select that option from the menu.

1. Highlight "Animated Execution."

2. Press the "Enter" key.

Entering the Number of Times to Run Your Model. You should see a small screen that asks you to enter the number of times that you want to execute your model (see Figure 35). WAA will execute your entire model the number of times you indicate. The time it takes for the simulation to complete its run is related to the number of times the model is run. As you would expect, the more times you run the model, the longer it takes for the simulation to finish. We recommend that you enter "1" the first time you execute the model. It will run faster that way, and you will learn whether there are any problems with your model before you spend a lot of time collecting data.

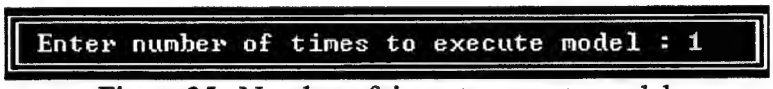


Figure 35. Number of times to execute model.

To enter the number of times to run your model, follow these steps:

1. Type "1."

2. Press the "Enter" key.

Entering a Random Number Seed. After you indicate the number of times you want to run your model, WAA will ask you to enter a random number seed on the screen shown in Figure 36. The random number seed is used to generate a set of random numbers that WAA uses to calculate the actual times for task performance and the probabilistic paths taken through your mission network.

Figure 36. Random number seed.

The same random number seed will always produce the same results for any particular mission. In other words, a random number seed of 1 will always produce the same execution times and sequence of tasks each time the simulation model is executed as long as the model itself does not change.

Now, enter a random number seed between 0 and 9999.

1. Type a random number seed.

2. Press the "Enter" key.

As the model executes, you will see the network diagram of the functions of your mission. Each function is a rectangle in the diagram. This view is consistent with the "Diagram" command on the function and task sequence templates. At the bottom of the diagram, you will see a control panel. Each of the commands is described below:

- c - Displays a "close up" view of the network diagram. This option provides a view of the network diagram that includes the function numbers and names.

- w - Displays a "wide" view of the network diagram. This option puts many more nodes on the screen than the "close up" view does, making each node smaller. Therefore, each node does not have enough room for the name and only includes the number.

- l - Displays a "layout" view of the network diagram. In this view, the mission network is scaled so that the entire diagram fits on a single screen. A dotted box outlines where the view will "zoom in" should you select the "close up" view at this time.

- arrows - The arrow keys can be used to move in the diagram. You can use each arrow key to pan the view in the same direction as the arrow. If you are in the "layout" view, you can also use the arrows to move the dotted box and control where you will "zoom in" if you then select the close view.

- f - This command allows you to change the network diagram from a diagram of functions, in which each function is a rectangle, to a network diagram of tasks. When you press the "f" key, you will be able to select the function for which you want to display the task network. You can change function views with this command as often as you wish.

- Home - The home key will reorient your view to the upper left-hand corner of the diagram you are currently viewing.

- v - This command enables you to make the control panel invisible, so that you can see more of the diagram. Even if the control panel is not visible, you will still be able to use all the commands.

• p - Use this command to print your network diagram. WAA supports IBM graphics compatible printers.

• ESC - To abort a mission model and exit the animation, press "ESC."

• space - To pause a simulation, press the space bar. Pressing the space bar once more will continue the simulation from the point it was paused. It is not necessary to pause the simulation before you use any of the commands on the control panel.

• "+" and "-" - The plus and minus keys can be used to speed and slow the animation. The "current speed" displayed below the control panel shows the speed level. The maximum speed is 20; the minimum speed is 1. This command is helpful if you are having difficulty watching the model run because it is moving too quickly.

As the model progresses, you will see symbols move throughout the network. The node that is currently executing will be highlighted. Sometimes, if you are watching the function network (where the nodes are rectangles), you will notice several symbols above a single function. This is because several tasks within that function are executing concurrently (because a multiple decision led to several parallel paths). If you want to see each of these tasks, follow these steps.

1. Press "f."
2. Highlight the name of the function you want to display.
3. Press the "Enter" key.

The network diagram for the function you selected is now displayed. If you would like, use the "F1" key for further instructions of how each command works.

You should notice that any continuous functions will be listed down the left-hand side of your sequence diagram. These functions will not have any paths to them. All other functions must have paths to them. If you have a discrete function without a path to it, WAA will tell you this when you enter the function sequence.

If you had chosen the "Normal Execution" option, instead of the network diagram, you would see the execution status screen. This screen gets updated at the end of each run. Since we are only running the model once, you would not see it change until the model is done. If you are

running a model multiple times, WAA will use the amount of time required for the first run to predict when all your runs will be finished.

It is possible to interrupt your model during execution by pressing the "ESC" key. All the data that have been collected so far will be saved, and you will be able to look at them in the next step.

Your model should take about a minute to run. When your model is finished, you will automatically be returned to the WAA step menu.

Step 9: Analyze simulation results. Now you are ready to look at the results of your labors. To do this, follow these steps:

1. From the WAA step menu, highlight option 9: "Analyze Simulation Results."

2. Press the "Enter" key.

The first screen that is displayed (see Figure 37) allows you to choose whether you want to analyze the performance time data or the workload data.

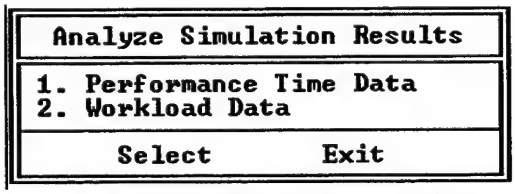


Figure 37. "Analyze Simulation Results" menu.

Analyzing Performance Time Data. To select this option, follow these steps:

1. Highlight "Performance Time Data."

2. Press the "Enter" key.

The next screen is called "Mission Performance," as shown in Figure 38. It will give you the mission time criterion (from Step 2) and the achieved mission time. The achieved mission time is the performance time that was simulated as a result of the individual tasks' performance times. If the achieved mission time is less than or equal to the mission time criterion, you will also see a message that says the mission passed the requirement. If the mission time criterion is less than the achieved mission time, then the mission failed its performance time criterion. If you

ran the model multiple times, the results shown on the remainder of the screen would summarize those results. The first run is reported separately because the workload profile you will be viewing is from the first run.

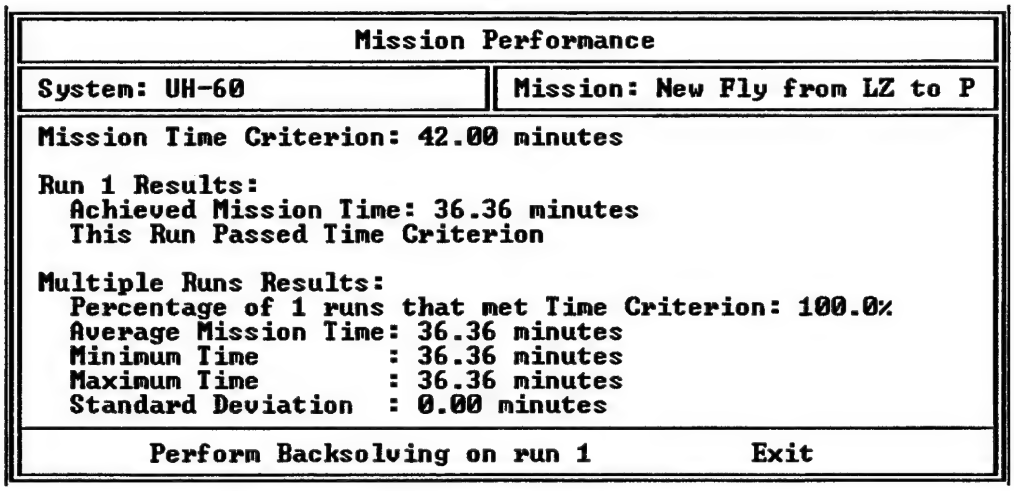


Figure 38. "Mission Performance" report.

The bottom of the screen has two commands, "Perform Backsolving" and "Exit." If your mission failed, you can backsolve through the tasks on the critical path to correct the failure. Backsolving will help you identify the problem-causing tasks if your mission did not meet the mission time criterion. If you ran your mission several times, the data you would see in this step would be taken from the first time the model executed.

If your mission failed only the time requirement, WAA will show you a list of the tasks on your mission's critical path. In addition, WAA will tell you the amount by which the mission time was exceeded. If you shorten the performance time estimate for any task in the list, you will shorten the performance time of the mission. WAA will help you adjust the performance times for the tasks.

The HELP screens in this step are quite extensive, so press "F1" if you are confused by any of the information on the backsolving screens. After you complete this step, you will have to return to Step 8 to re-execute the mission model.

When you are finished, return to the "Analyze Simulation Results" menu:

1. Highlight "Exit"

2. Press the "Enter" key.

Analyze Workload Data. Now, choose the second option on the "Analyze Simulation Results" menu:

1. Highlight "Workload Data."

2. Press the "Enter" key.

Now, a small menu appears, as shown in Figure 39, with three choices on it.

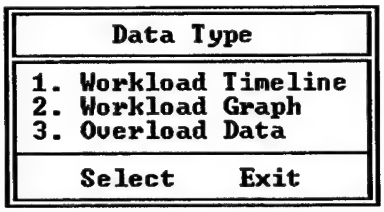


Figure 39. "Data Type" menu.

Each of these is described below.

• Workload Timeline - Use this to display an exhaustive breakdown of each crew member's workload in each channel throughout the mission timeline. In addition, you can display all the tasks that are being performed by any operator at any time throughout the mission timeline.

• Workload Graph - Use this option to display a graph of workload versus time for either one crew member and several channels or multiple crew members in a single channel.

• Overload Data - Use this option to receive reports of any times during the mission timeline that any crew member was in overload. In addition, this option will help you reallocate tasks that led to overload to other operators that have access to the controls and displays necessary to perform the tasks. If you executed the mission multiple times, this report will also include a summary of how many times each task started during an overload situation.

Follow these steps to view each option:

Viewing the Mission Timeline. Use these steps to view the mission timeline:

1. Highlight "Workload Timeline."

2. Highlight "Select."

3. Press the "Enter" key.

A screen should now appear as shown in Figure 40. The data apply to the crew member identified at the top of the screen.

Workload Timeline for Run 1	Crew Member: Pilot					
Time (minutes)	Workload Channels Vis	Aud	Cog	Psych	# Ongoing Tasks	Overall Workload
0.000	1.0	4.9	9.0	0.0	2	18.0
0.060	1.0	4.3	9.0	2.2	2	18.0
0.070	0.0	4.3	5.3	2.2	1	10.6
0.080	1.0	4.3	6.5	2.2	2	13.0
0.110	4.0	4.3	12.1	2.2	2	24.2
0.120	4.0	0.0	6.8	0.0	1	13.6
0.170	0.0	0.0	0.0	0.0	0	0.0
0.200	4.0	0.0	1.2	0.0	1	2.4
0.220	7.0	0.0	3.7	0.0	1	7.4
▼ 0.310	7.0	0.0	3.7	0.0	1	7.4
Display Ongoing Tasks		Select Crew Member		Exit		

Figure 40. Workload timeline for pilot.

The contents of each of the columns on this screen are defined below.

- Column 1 - Time - The leftmost column of the screen contains performance times. These times are not evenly spaced, since WAA is event driven instead of time driven. The times represent when this crew member began or ended a task.

- Columns 2 - 5 - Workload Channels - The next four columns include scores in each of the four workload channels. If more than one task was being performed by this crew member at any one time, then the scores in these columns are calculated by summing the values in each channel for each ongoing task.

- Column 6 - # of Ongoing Tasks - This column contains the number of ongoing tasks being performed by this crew member for each time reported on the mission timeline.

- Column 7 - Overall Workload - The rightmost column includes the overall workload channel value. If you chose not to identify an overall workload channel, the values in this column will all be zeros.

To display the tasks this crew member is performing at any time in the mission, follow these steps:

1. Highlight "Display Ongoing Tasks."

2. Press the "Enter" key.

The tasks, along with their associated workload levels, should now be displayed, as shown in Figure 41.

Ongoing Tasks	Simulation Time: 0.000 minutes			
Function/Task Name	Workload Channels Vis	Aud	Cog	Psych
1. Perform Cockpit Comm/Receive (Pilot)	0.0	4.9	5.3	0.0
2. Monitor Threat/Check Direction Display (	1.0	0.0	3.7	0.0
Total Attentional Demands:	1.0	4.9	9.0	0.0
Select Next Time		Exit		

Figure 41. "Ongoing Tasks" report.

To return to the mission timeline, follow these steps:

1. Highlight "Exit."

2. Press the "Enter" key.

You can display the mission timeline for any other crew member by following these steps:

1. Highlight "Select Crew Member."

2. Press the "Enter" key.

3. Highlight the crew member for whom you want to display the mission timeline (example: "Copilot").

4. Press the "Enter" key.

Now a mission timeline for the other crew member is shown (see Figure 42).

Workload Timeline for Run 1	Crew Member: Copilot					
Time (minutes)	Workload Channels Vis	Aud	Cog	Psych	# Ongoing Tasks	Overall Workload
0.000	16.0	5.3	12.4	10.2	5	24.8
0.010	12.0	9.6	16.5	6.6	5	33.0
0.020	12.0	9.6	16.5	6.6	5	33.0
0.040	12.9	9.6	19.0	6.6	5	38.0
0.050	12.9	10.2	19.0	4.4	5	38.0
0.060	12.9	9.2	18.0	4.4	4	36.0
0.070	12.9	9.8	18.0	2.2	4	36.0
0.080	5.9	9.8	14.3	2.2	3	28.6
0.120	5.9	9.8	11.8	5.8	3	23.6
0.140	5.9	4.3	6.5	8.0	2	13.0
Display Ongoing Tasks			Select Crew Member		Exit	

Figure 42. Workload timeline for copilot.

When you are finished viewing the mission timeline, return to the "Data Type" menu:

1. Highlight "Exit."
2. Press the "Enter" key.

Displaying a Workload Graph. Follow these steps to display a workload graph:

1. Highlight "Workload Graph."
2. Highlight "Select."
3. Press the "Enter" key.

Now, you will see a screen from which you can choose the type of graph you want to display, as shown in Figure 43. You can either graph one crew member and multiple workload channels or multiple crew members and a single workload channel.

Type of Graph
1. One Crew Member - Multiple Channels 2. Multiple Crew Members - One Channel
Select Exit

Figure 43. "Type of Graph" menu.

First, choose one crew member, multiple channels:

1. Highlight "One Crew Member - Multiple Channels."

2. Highlight "Select."

3. Press the "Enter" key.

Now, a list of crew members will be displayed (see Figure 44) from which you can select the crew member whose workload you want to graph.

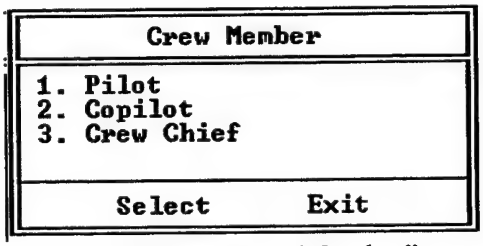


Figure 44. "Select Crew Member" menu.

1. Highlight a crew member (example: "Pilot").

2. Highlight "Select."

3. Press the "Enter" key.

Now a list will be displayed (see Figure 45) from which you can select multiple workload channels to have the data plotted on the graph.

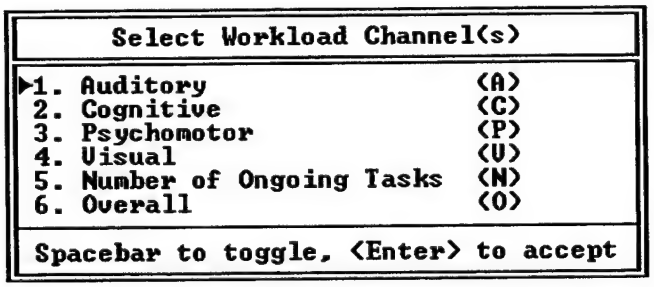


Figure 45. "Select Workload Channel(s)" menu.

Follow these steps to select workload channels:

1. Highlight the first channel you want to select (example: "Cognitive").

2. Press the "space bar."

3. Repeat Steps 1 and 2 until you have marked the channels or other information you want to graph.

4. Press the "Enter" key.

Now, a workload graph will display that shows the values of the workload variables in each of the channels you marked. The x-axis of the graph is time and includes the complete mission duration. The y-axis of the graph is the computed workload (based on the channel(s) you selected) for the crew member you identified. In Figure 46, we just selected the auditory channel to show an example graph.

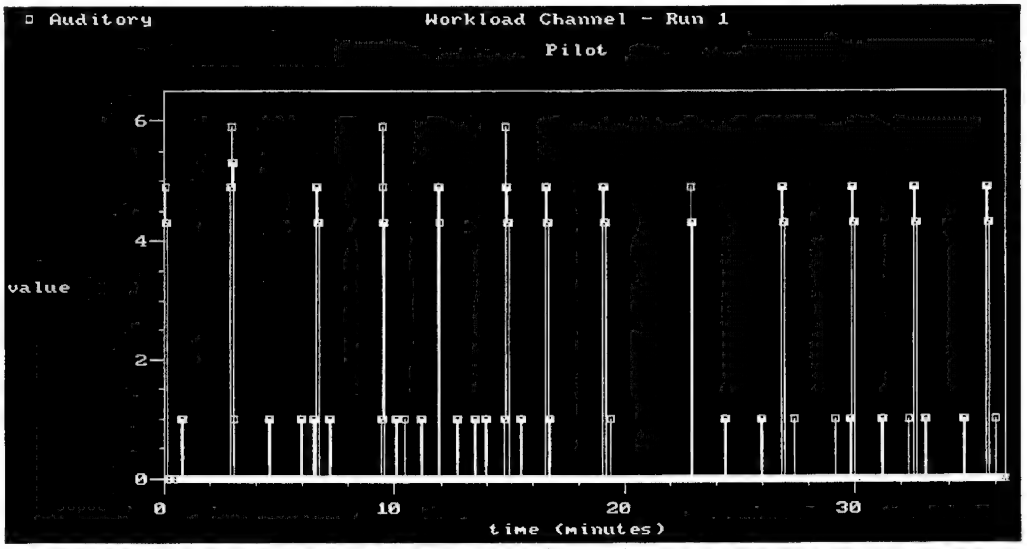


Figure 46. Example of workload graph.

To leave the graph, follow these steps:

1. Press the "Enter" key.

2. Press "Escape" twice to close the menus.

If you want to display a graph of multiple crew members' workload for one workload channel, follow these steps:

1. From the "Type of Graph" menu, highlight the second option: "Multiple Crew Members - One Channel."

2. Press the "Enter" key.

3. From the "Workload Channel" screen, highlight the one channel in which you are interested (example: "Cognitive").

4. Press the "Enter" key.

5. From the "Select Crew Members" screen, highlight a crew member (example: "Pilot").

6. Press the "space bar."

7. Repeat Steps 5 and 6 to include as many as four crew members.

8. Press the "Enter" key.

Now a workload graph will be displayed that looks similar to the example workload graph shown previously in Figure 46 except that it now shows the workload values representing a single channel for each of the crew members selected. The x-axis of the graph is time and includes the complete mission duration. The y-axis of the graph is the workload value for the one channel selected.

To leave the graph, follow these steps:

1. Press the "Enter" key.

2. Press the "Escape" key twice to close the menus.

To return to the "Data Type" menu, follow these steps:

1. Highlight "Exit."

2. Press the "Enter" key.

Viewing Overload Data. The third option on the "Data Type" menu will allow you to display data showing where and how crew members reached an overload state. If no overloads occurred during the simulation for some reports, the data will show zeros, and for other reports, there will not be any data to review. To review overload data, follow these steps:

1. Highlight "Overload Data" on the "Data Type" menu.

2. Press the "Enter" key.

A small menu displays, see Figure 47, showing the three reports of overload data which you can review.

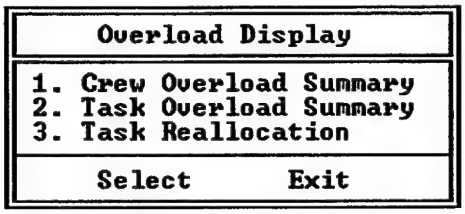


Figure 47. Types of overload data.

These are described below.

• Crew Overload Summary - This option identifies the percentage of time that each crew member spent in workload overload. It also identifies the number of points in the mission timeline where overload existed for each crew member. This report includes data across multiple model runs (if you entered a value > 1 in "Number of Times to Execute Mission").

• Task Overload Summary - This option identifies the number of times each task was initiated and the number of times that the task started when the assigned operator was in workload overload. This report includes data across multiple model runs if you ran the model more than once.

• Task Reallocation - In this option, WAA helps you reallocate tasks that were performed during an overload condition to a different crew member. If you ran the model multiple times, this report is compiled from the first model run.

Viewing the Crew Overload Summary. To view the crew overload summary, follow these steps:

1. Highlight "Crew Overload Summary."

2. Highlight "Select."

3. Press the "Enter" key.

The "Crew Overload Summary" will display, as shown in Figure 48. This report summarizes the amount of time each crew member spent in an overload condition. Here, you can see that none of the crew members reached an overload condition during the simulation. You can use the "Crew Member Graph" command at the bottom of the screen to display the workload graphs as described previously.

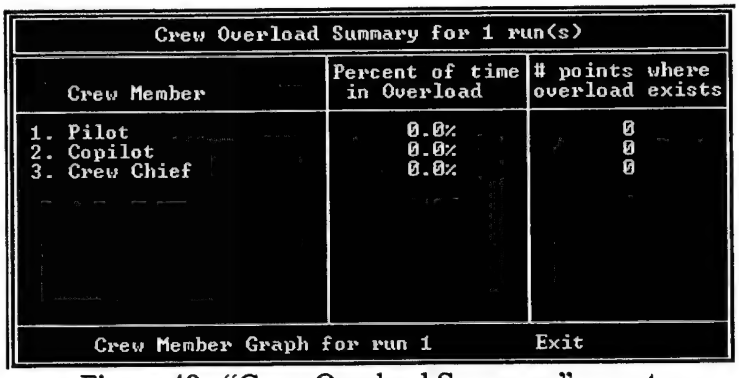


Figure 48. "Crew Overload Summary" report.

To return to the "Overload Display" menu, follow these steps:

1. Highlight "Exit."

2. Press the "Enter" key.

Viewing the Task Overload Summary. To view the task overload summary, follow these steps:

1. From the "Types of Overload Data" menu, highlight option 2: "Task Overload Summary."

2. Highlight "Select."

3. Press the "Enter" key.

The task overload summary will now display, as shown in Figure 49. This report summarizes the number of times each task was performed and the number of times that the task began execution while the crew member assigned to the task was in workload overload. You can use this to identify specific tasks that contribute to overloads.

To return to the "Overload Display" menu, follow this step:

1. Press the "Enter" key.

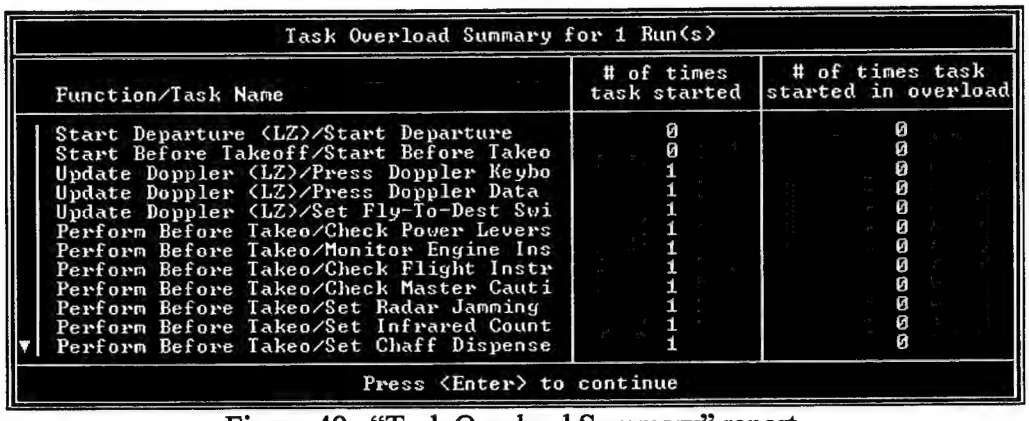


Figure 49. "Task Overload Summary" report.

Performing Task Reallocation. If any of your operators were in workload overload at any time during your mission, you can reallocate tasks between operators in an attempt to alleviate the overload condition. In this step, WAA helps you perform this reallocation. You cannot reallocate tasks unless your mission had any points of overload. Since this example mission for the tutorial does not have overloads, we will briefly show how it is done.

Follow these steps:

1. From the "Types of Overload Data" menu, highlight option 3: "Task Reallocation."
2. Highlight "Select."
3. Press the "Enter" key.

The screen you should see now has three methods for reallocating tasks, as shown in Figure 50.

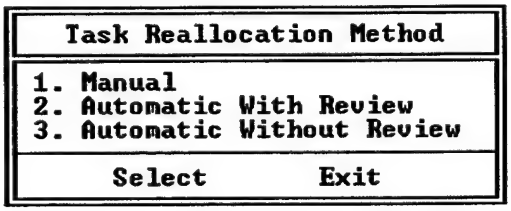


Figure 50. "Task Reallocation Method" menu.

Each of these is discussed below:

- Manual - If you choose manual reallocation, each point in the mission where an operator entered overload will be presented. You can then decide whether to assign that task to a different operator or whether to leave the assignment as is.

- Automatic with Review - If you choose this reallocation method, WAA will present each overload point, along with a recommendation for reassignment. You can either accept or reject WAA's recommendation.

- Automatic Without Review - If you choose this reallocation method, WAA will process each overload point and make reassignments automatically.

To choose a task reallocation method,

1. Highlight "Manual."
2. Highlight "Select."
3. Press the "Enter" key.

Since there are no overloads, you will not be able to go further. If there were overloads, you would choose the crew member whose tasks you want to reallocate on the next screen that displays. Follow these steps:

1. Highlight a crew member that was in overload (example: "Copilot").
2. Press the "Enter" key.

The next screen would show the details about the first point of overload that your selected crew member experienced. The screen contains the following information (for your future reference):

- Top Row - On the top row of this screen, the crew member's name and the simulation time at which this point of overload occurred are listed.

- Second Line - The second line of the screen contains the number of parallel tasks that this crew member was trying to perform at the time of the overload. In addition, the second line

contains the overall workload channel value. If you did not define an overall channel, this value will be 0.0.

- Lines 3 - 9 - Lines 3 through 9 contain specific information about the ongoing tasks. This information includes the workload values in each channel for each task.

- Near the Bottom - Near the bottom of the report is a line titled "Total Attentional Demands" which contains the sum of the workload values in each of the channels.

- At the Bottom - At the bottom of the report is a line titled "Violates Definition:" which contains the workload threshold that was violated and caused this point of overload.

The command bar shows three commands. To use "Reallocate Task,"

1. Highlight a task you want to reallocate.
2. Highlight the "Reallocate Task" command.
3. Press the "Enter" key.

Now, a box will display that lists the other crew members in your system who have access to the task that you want to reallocate. In addition, estimates of what the total workload values of each of the crew members listed would be if you reallocated the task to them, are displayed. You can select one of these crew members as follows:

1. Highlight a crew member.
2. Press the "Enter" key.

You can use the "Next Overload" command to progress to the next point of overload to reallocate tasks for it. When you are finished reassigning tasks, follow these steps:

1. Highlight "Exit."
2. Press the "Enter" key.

The other two options on the "Task Reallocation Method" menu (see Figure 50) are "Automatic With Review" and "Automatic Without Review." With both of these options, WAA will reallocate tasks. With the first option, you can review the changes as WAA reallocates the tasks. In the second option, WAA reallocates tasks without your review. Then

you must run the simulation again to see the results of the new tasks assignments. Note. Since reallocating tasks changes your task assignment, you may wish to make a backup copy of your original analysis before proceeding (see pages 20-21 for copying instructions).

To exit task reallocation and return to the WAA step menu, follow these steps:

1. Highlight "Exit" on the "Overload" screen.
2. Press the "Enter" key.
3. Highlight "Exit" on the "Task Reallocation Method" menu.
4. Press the "Enter" key.
5. Highlight "Exit" on the "Data Type" menu.
6. Press the "Enter" key.
7. Highlight "Exit" from the "Analyze Simulation Results" menu.
8. Press the "Enter" key.

Step 10: Print reports. In this step, you can look at the results of your model to learn whether the performance estimates at the task level were sufficient to enable the mission to be performed within the time specified in Step 2. In addition, this step identifies the reports that document the information you entered in all of the previous steps. Below, we list the reports and a short statement about what is included in each of them.

- System Description - Includes the mission area, system type, system name, and version number of your system.

- Mission Description - This report lists the functions and tasks in your mission. It does not include any sequence information.

- Mission Conditions - This report documents the environmental, tactical, terrain, and friendly force conditions you selected for this mission.

- Function Sequence - This report provides a printout of the information you entered on the function sequence template. This report does not include a network diagram. If you want a printout of the network diagram, you will have to return to Step 3 and display the diagram; then use the "P" command on the control panel.

• Task Sequence - This report provides a printout of the information you entered on the task sequence templates, which includes information about task order. This report does not include a network diagram. If you want a printout of the network diagram, you will have to return to Step 4 and display the diagram; then use the "P" command on the control panel.

• Crew Position Summary - Use this report to print a list of the crew members you identified for your system.

• Function Data - Use this report to obtain a printout of all the functions in your mission, as well as the maximum acceptable time standard you entered for each of them. For continuous functions only, the most likely and fastest times between occurrences are also included in this report.

• Task Data - Use this report to obtain a printout of all the tasks in your mission, as well as the performance standards and estimates entered for each of them.

• Mission Time Performance - This report provides documentation of the results of your mission simulation. In addition to the information included in the previous report, it includes the number of times the mission was executed and the percentage of those times that met the mission performance time standard.

• Function Time Performance - This report provides documentation of the function-level results of your mission simulation. It lists the functions in your mission, the number of times that each function was executed, the performance time standard for each function, and the percentage of time that the time standard was met.

• Task Time Performance - This report provides documentation of the task-level results of your mission simulation. It lists the tasks in each function in your mission, the number of times that each task was executed, and the percentage of those times that met the task time standard.

• High Workload Definitions - This report lists the definitions of high workload entered in Step 7.

• Crew Overload Summary - The crew overload summary reports the percentage of time that each crew member was in overload and the number of points where overload existed for each crew member.

• Task Overload Summary - The task overload summary contains the number of times each task started and the percentage of those times that the crew member assigned to perform the task was overloaded when the task began.

• Workload Timeline - This timeline is a listing of each crew member's workload at each point in the mission timeline. The report also contains the current number of ongoing tasks and the value of the overall workload channel. This report will be available even if you reallocated tasks in the previous step. Remember that the results from this report (and all other reports) are from the most recent model run.

To display these reports, follow these steps:

1. From the WAA step menu, highlight "Display and Print Reports."

2. Press the "Enter" key.

A list of the reports is displayed in Figure 51.

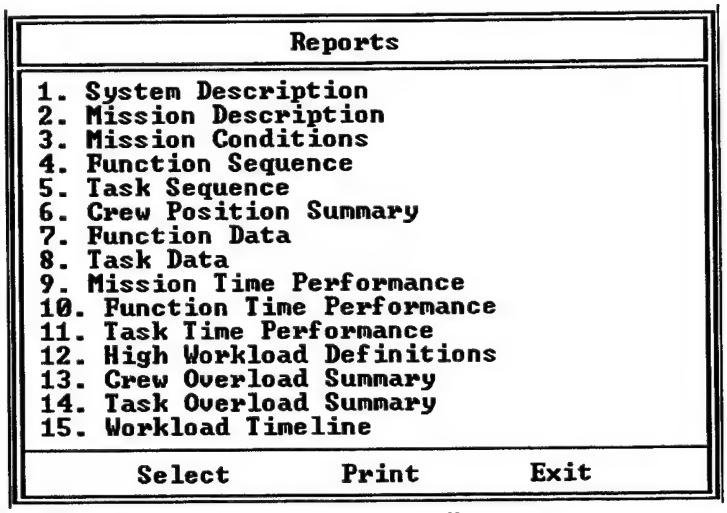


Figure 51. "Reports" menu.

To select a report, follow these steps:

1. Use the vertical arrow keys to highlight the report you want to display.

2. Highlight "Select."

3. Press the "Enter" key.

The report you selected will be displayed. When you are finished looking at each report, press "Enter" to return to the "Reports" menu. From here, you can continue to select reports that you want to view. You can use the "Print" command to print any reports.

Note. If you print a report and the lines and borders are replaced by alphabetic characters, your printer is not correctly specified, and you must use the utilities program to specify the correct printer. For further information, use the "F1" HELP command in Perform Utilities, or read Section 7 of this user's guide.

We have finished discussing the analyze reports step, the last step in WAA. Follow these steps to return to the MAN-SEVAL main menu:

1. Highlight "Exit" on the report you have displayed.
2. Press the "Enter" key.
3. Highlight "Exit" on the WAA step menu.
4. Press the "Enter" key.

The MAN-SEVAL main menu is displayed (see Figure 1). Now you have completed the explanation of the WAA steps in MAN-SEVAL. Next we will proceed to the MMAA steps.

MAINTENANCE MANPOWER ANALYSIS AID (MMAA)

Use MMAA to determine how much maintenance your system will need for a variety of scenarios. As in WAA, MMAA contains large data libraries that you can access. These libraries contain maintenance data for 16 Army weapon systems, including helicopters, howitzers, tanks, and trucks. You will be able to select data from one of these existing missions and modify them to fit your needs, or you could enter new data from scratch.

After you identify the system you wish to analyze, you will see the MMAA step menu. This menu lists the steps that you will follow to describe the system you have identified. In this section, we describe each one of these steps in detail.

Beginning Work on a New System

You should now be at the MAN-SEVAL main menu. The first item on this menu is "Begin Work on a New System." To continue, follow these steps:

1. Highlight "Begin Work on a New System."

2. Press the "Enter" key.

Now, MAN-SEVAL will ask you to make some selections to classify your system. First, identify the mission area to which your new system belongs, as shown in Figure 52. You can choose any mission area for this tutorial.

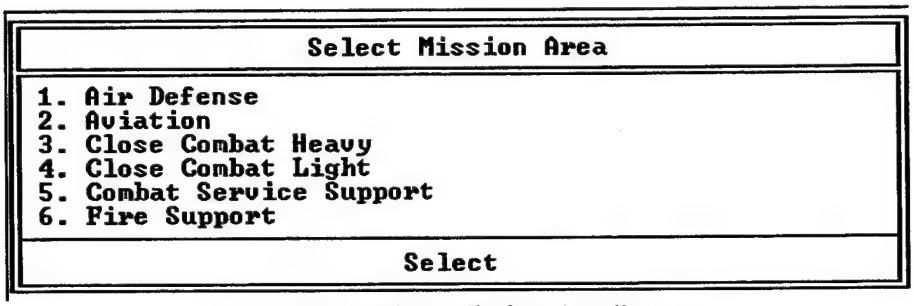


Figure 52. "Select Mission Area" menu.

To select a mission area:

1. Use the arrow keys to highlight a mission area (example: "Fire Support").

2. Press the "Enter" key.

MAN-SEVAL displays a list of system types for the mission areas, as shown in Figure 53. You can select one of these types or use the "Type in" command to enter a new one.

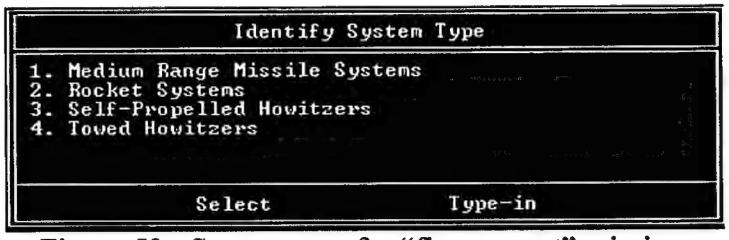


Figure 53. System type for "fire support" mission.

To select a system type, follow these steps:

1. Use the down arrow to scroll to the system type you want to select (example: "Towed Howitzers" - This is the system type you will use in this tutorial).

2. Highlight "Select."

3. Press the "Enter" key.

MAN-SEVAL asks you to type your system name, as shown in Figure 54.

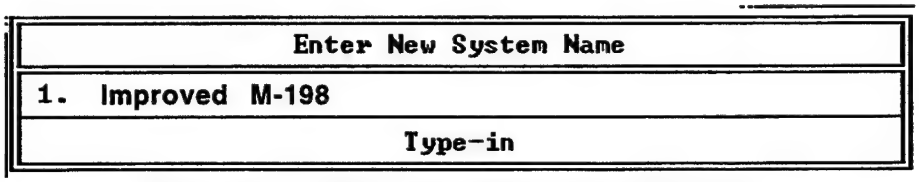


Figure 54. "Enter a New System Name" screen.

To do this, follow these steps:

1. Type a name for your new system (example: "Improved M-198").

2. Press the "Enter" key.

Now, MAN-SEVAL asks you to enter a version for your new system, as shown Figure 55. This is optional. If you do enter a version name, the information is displayed with the system on the "Existing Systems" screen (see Figure 2).

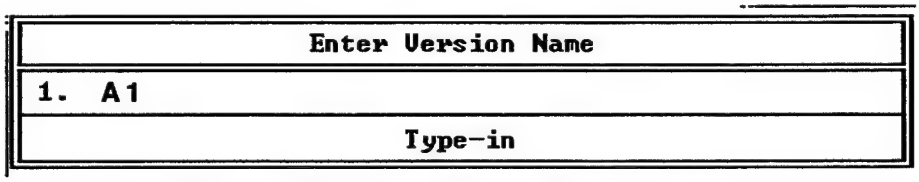


Figure 55. "Enter a Version Name" screen.

1. If you want to enter a version for your new system, type it (example: "A1").

2. Press the "Enter" key.

Now a small menu displays, which you have seen before, showing the two parts of MAN-SEVAL (see Figure 3). Since we are starting the MMAA portion of this tutorial, follow these steps:

1. Highlight option 1: "Maintenance Manpower Analysis."

2. Press the "Enter" key.

If the maintenance manpower analysis option is ever "greyed out" on this menu, it is because you are working on a library system that does not have maintenance data available. When this happens, use the F1 key to access help, and then press "D" for more data-related information.

You will see the MMAA step menu (see Figure 56). There are four steps on this menu. This tutorial will go through them in the order in which they are listed.

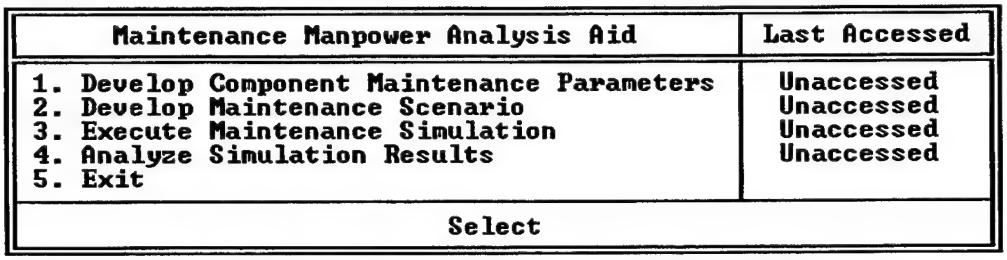


Figure 56. MMAA step menu.

Step 1: Develop component maintenance parameters. In Step 1 of MMAA, you will identify the characteristics of the hardware involved in your system design. There is quite a bit of information to enter in order to model all aspects of the hardware to full detail. Follow these steps to begin this first step:

1. From the MMAA step menu, highlight option 1: "Develop Component Maintenance Parameters."

2. Press the "Enter" key.

This step consists of three substeps as listed on the menu shown in Figure 57. In the first substep, you can change the names of the five maintenance tasks. The default names are troubleshoot, remove and replace, inspect, adjust and repair, and test and check. If you choose to change any (or all) of these task names, be aware that most of the reports print only the first 14 characters of the name (i.e., two lines of seven letters each). Try to make the new task name as meaningful as possible.

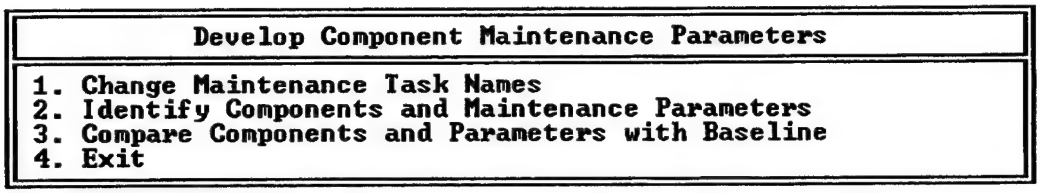


Figure 57. "Develop Component Maintenance Parameters" menu.

The remove and replace task can be associated with "off-line" maintenance. This means that you can specify that after a component is "removed and replaced" it will then be repaired "off line" (or separately) from your system. This capability is more thoroughly discussed later in this section of the User's Manual. However, if you do edit the remove and replace task name, MMAA will warn you that this task (regardless of what you name it) is the only one that can be associated with the off-line maintenance option.

Follow these steps to begin this process:

1. Highlight "Change Maintenance Task Names."

2. Press the "Enter" key.

You should see a small pop-up menu titled "Choose Task Name to Modify" (see Figure 58). The first five items on the menu list the current maintenance task names. The sixth item enables you to return to the default names. The last item is used to save your changes and exit from the menu. If you want to cancel your changes, you will use the "Esc" key.

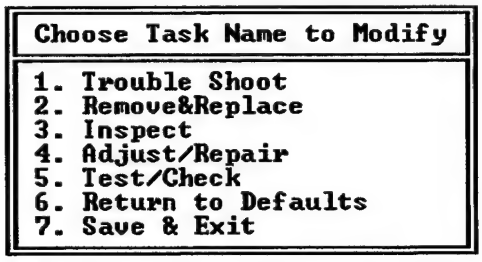


Figure 58. "Choose Task Name to Modify" menu.

To change a maintenance task name, follow these steps:

1. Use the up and down arrow keys to highlight a task you want to change (example: "Troubleshoot").

2. Press the "Enter" key.

3. Type the new name (example: "Do BITE").

4. Press the "Enter" key.

5. Repeat Steps 1 through 4 until you are finished changing any names.

6. Highlight "Save & Exit."

7. Press the "Enter" key.

Now you will be back at the menu titled "Develop Component Maintenance Parameters" (see Figure 57). In the second substep, you will enter the maintenance data for your system. First, you will break your system down into its subsystems and break each subsystem down into its components. Then, you will identify the maintenance tasks associated with each component and enter the parameters for each task.

To begin the second substep, follow these steps:

1. Highlight the second option "Identify Components and Maintenance Parameters" on the "Develop Component Maintenance Parameters" menu.

2. Press the "Enter" key.

The screen you should see now is titled "Identify Maintenance Subsystems" as shown in Figure 59. Since you are beginning work on a new system, this screen will be empty. The first thing you will do is copy a subsystem from the library into your new system.

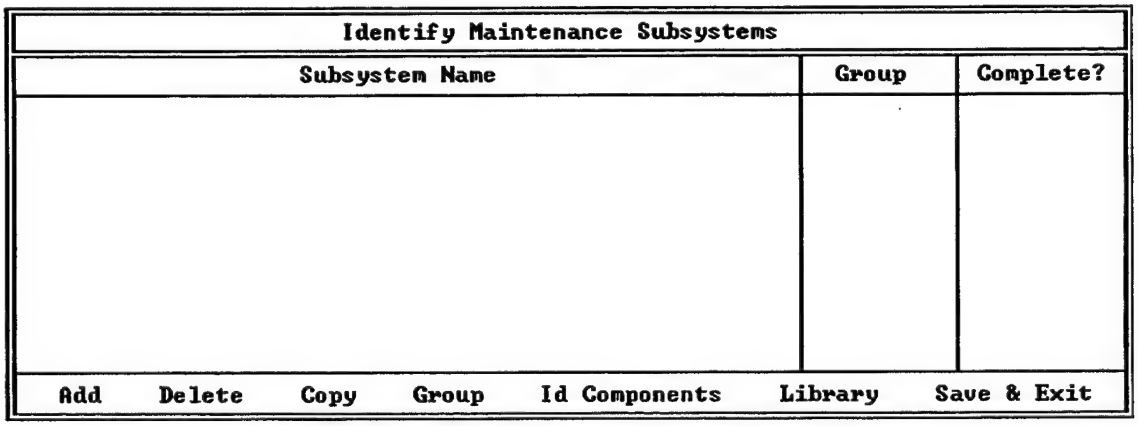


Figure 59. "Identify Maintenance Subsystems" screen.

To do this, follow these steps:

1. Highlight "Library."

2. Press the "Enter" key.

On the next screen, you will see the list of existing systems as shown in Figure 60.

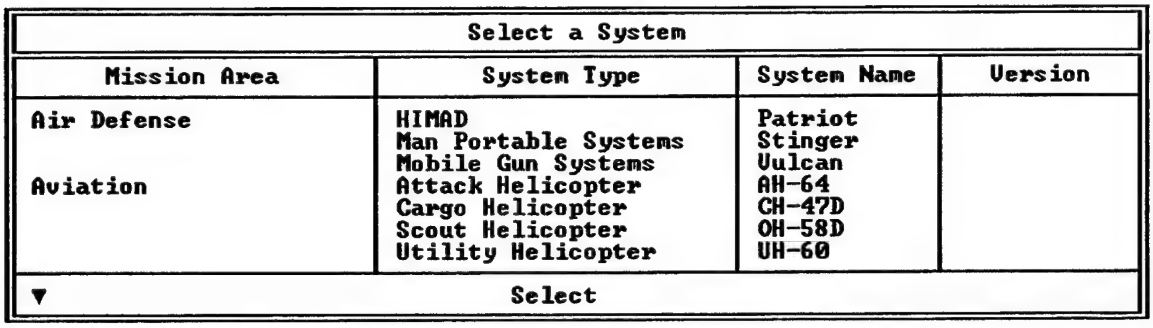


Figure 60. "Select a System" menu.

1. Highlight the system that has a subsystem that is similar to one that is in your system (example: "M-198").

2. Press the "Enter" key.

You will see a small screen with a list of the subsystems that are in the existing system you chose (see Figure 61).

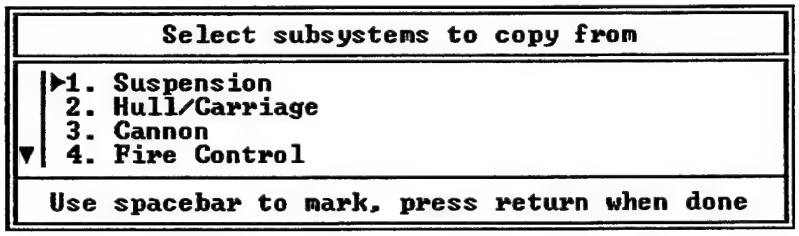


Figure 61. "Select Subsystems to Copy from" menu.

To copy one of these subsystems into your new system, follow these steps:

1. Highlight a subsystem (example: "Suspension").

2. Press the "space bar."

3. Press the "Enter" key.

You should now see your list of subsystems and there should be one subsystem listed, the one you just copied. There are three columns in this screen. The contents of these are summarized below.

• Column 1 - Subsystem Name - The left-most column includes the subsystem name. Examples of subsystems are "engine," "turret," and "tracks and wheels."

• Column 2 - Group - The second column includes the group name. The subsystems in MMAA are classified into nine equipment groups. There are seven "Armaments" groups (to accommodate as many as seven different armaments subsystems), one "Mobility" group, and one "Other" group. Components from subsystems that are classified as armaments subsystems will have failure rates that are based on the number of rounds fired by the system. Examples of these components are gun tubes and triggers. Components from subsystems that are classified as mobility subsystems will have failure rates that are based on the distance the system has traveled (flight hours, miles, kilometers). Examples of these components include rotors, tracks, and wheels. The remaining components will be those from subsystems that are classified as other subsystems. These components will have failure rates based on the amount of time the system has operated. Examples of these components are radios, gauges, and electronic equipment.

• Column 3 - Complete? - The right-most column provides an indication of those subsystems for which you have entered components. If you leave this step before you are finished, this column will help to remind you where you ended work.

Identifying the Equipment Group to Which Each Subsystem Belongs. The first three commands at the bottom of the screen are self explanatory. The fourth command is "Group." Follow these steps to use the "Group" Command:

1. Highlight a subsystem (example: "Suspension").

2. Highlight "Group."

3. Press the "Enter" key.

Now a small menu is displayed (see Figure 62). Choose the equipment group to which the highlighted subsystem belongs.

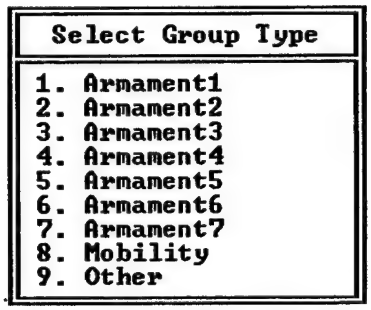


Figure 62. "Select Group Type" menu.

If you have more than one gun on your system, you will want to classify each one as a different armaments subsystem. In this way, you can specify different usage rates for each (in terms of rounds fired each day). This helps you correctly represent how often the components in each gun fail.

To choose the equipment group, follow these steps:

1. Highlight the equipment group to which the highlighted subsystem belongs (example "Mobility").

2. Press the "Enter" key.

The "Library" command enables you to search the MMAA library of existing maintenance data and to select subsystems from the library that you want to copy into your system. If your new system was an armored vehicle and it had a turret like the M1 Tank, you could use this command to copy all the components of the M1 turret into your list. When you copy a subsystem from the library, the component list and all the maintenance parameter data will be copied with it. This can greatly minimize the amount of data you have to enter.

Breaking Each Subsystem Down Into its Components. Use the "Id Components" command to break each subsystem into its components and to enter maintenance parameter data for each component. The following steps show you how to use this command.

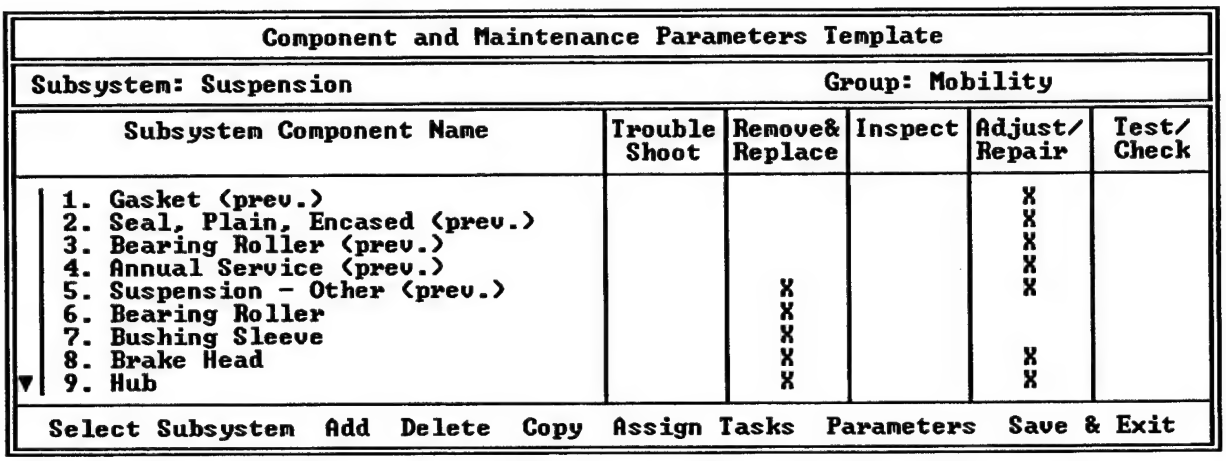
1. Highlight a subsystem (example: "Suspension").

2. Highlight "Id Components."

3. Press the "Enter" key.

4. You will be asked whether you want to save the changes so far before going to the component level. Press "Y."

Now, you should see a screen that has six columns as shown in Figure 63. The left-most column includes the names of the components that have been entered for the subsystem you highlighted in the previous screen. The remaining five columns represent the five maintenance tasks that are available in MMAA. (If you changed maintenance task names previously, those new names will appear here.)



Component and Maintenance Parameters Template

Subsystem: Suspension — Group: Mobility

Subsystem Component Name	Trouble Shoot	Remove& Replace	Inspect	Adjust/ Repair	Test/ Check
1. Gasket (prev.)				X	
2. Seal, Plain, Encased (prev.)				X	
3. Bearing Roller (prev.)				X	
4. Annual Service (prev.)				X	
5. Suspension - Other (prev.)		X		X	
6. Bearing Roller		X			
7. Bushing Sleeve		X			
8. Brake Head		X		X	
9. Hub		X		X	

Select Subsystem Add Delete Copy Assign Tasks Parameters Save & Exit

Figure 63. "Component And Maintenance Parameters Template" screen.

The commands at the bottom of the screen enable you to change subsystems, add components to the list, delete components from the list, copy components in the list to different names, and save your work. We will discuss the remaining two commands, "Assign Tasks" and "Parameters," in more detail.

Identifying the Maintenance Tasks that will be Performed on each Component. You will use the "Assign Tasks" command to select one or more maintenance tasks that will be performed on each component in your subsystem.

Follow these steps to assign each component to one or more maintenance tasks:

1. Highlight a component for which you want to assign maintenance tasks (example "Gasket").

2. Highlight "Assign Tasks."

3. Press the "Enter" key.

You should now see a small screen on which are listed the six possible maintenance tasks (see Figure 64). (Notice that OFFLINE is included as a separate task.) As we discussed before, off-line maintenance is performed on a component after it is removed from the system and after a system is returned to mission-ready status. Since this type of maintenance also requires man-hours, it is important to account for the people and time needed for off-line maintenance.

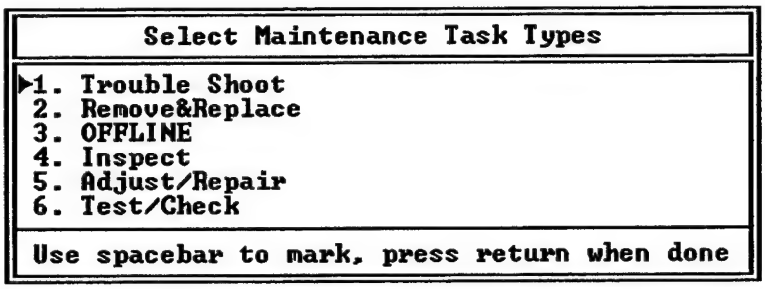


Figure 64. "Select Maintenance Task Types" screen.

Since off-line maintenance requires the component to be removed and replaced with a new one, it is always associated with the "Remove & Replace" task in MMAA. If you select "OFFLINE" from the screen you now see, you will automatically be selecting "Remove & Replace" as well.

Follow these steps to select one or more tasks:

1. Highlight the first task that is likely to be performed on the highlighted component (example: "OFFLINE").

2. Press the "space bar."

3. Repeat Steps 1 and 2 until you have marked all the tasks that apply to the highlighted component.

4. Press the "Enter" key.

Now, X's should be displayed under each of the tasks you marked for the highlighted component. If you selected "OFFLINE," you will notice that the "Remove & Replace" column is marked with an "XO" to indicate that you are doing a remove and replace as well as an off-line repair of the component that was removed.

Entering the Maintenance Parameters. Use the "Parameters" command to enter the maintenance parameters that apply to each component-maintenance task pair that you identified

To begin this process, follow these steps:

1. Highlight "Parameters."

2. Press the "Enter" key.

3. If you are prompted to save your changes, press the "Y" key.

You should now see the "Establish Maintenance Parameters" menu with six items on it (see Figure 65).

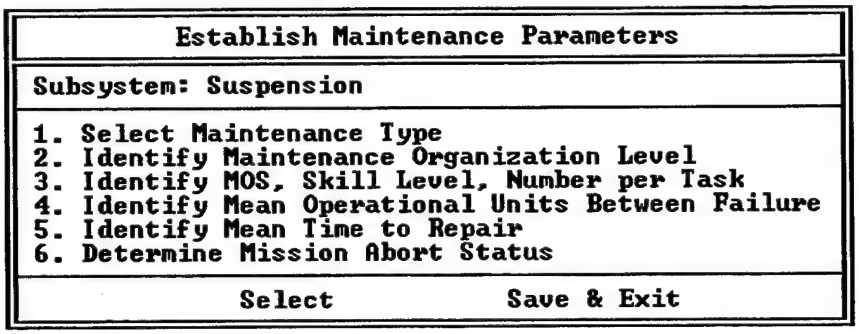


Figure 65. "Establish Maintenance Parameters" menu.

Each of these is summarized below.

• Select Maintenance Type - In this substep, you will identify each maintenance action as either preventative or corrective maintenance. For example, if you assigned the radio component to the remove & replace task, then you would probably identify this maintenance action as corrective, whereas you may identify the "Oil Filter - Inspect" maintenance action as preventative.

• Identify Maintenance Organization Level - In this substep, you will identify the maintenance organization level that is most likely to perform each maintenance action. MMAA models three levels of maintenance. These are typically organizational (ORG), direct support (DS), and general support (GS). For Army aviation systems, MMAA includes maintenance data for two organization levels. These are aviation unit maintenance (AVUM) and aviation intermediate maintenance (AVIM). MMAA does not model depot-level maintenance. If any of your maintenance actions will be performed by more than one organization level, you must list the component twice.

• Identify MOS, Skill Level, Number per Task - Use this substep to identify the MOS of the maintainer most likely to perform each maintenance action. In addition, you will identify the skill level of that maintainer and the number of each MOS needed to perform the action. You can assign two different MOSs to each maintenance action.

• Identify Mean Operational Units Between Failure (MOUBF) - Use this substep to enter how often each maintenance action is likely to be performed. If the subsystem you are working on belongs to the armaments group, this failure rate will be in "Mean Rounds Fired Between Failure (MRBF)." If the subsystem belongs to the mobility group, the failure rate will be specified in "Mean Distance Traveled Between Failure (MDBF)." Finally, if the subsystem belongs to the other group, the failure rate will be specified in "Mean Time Between Failure (MTBF)."

• Identify Mean Time to Repair (MTTR) - In this substep, you will enter the amount of time it is likely to take to perform each maintenance action. This value is in hours and represents elapsed time.

• Determine Mission Abort Status - In this final substep, you will indicate the probability that the need for each maintenance action will cause the mission that is currently being performed to abort.

Now, we will show you how to enter the data in each substep.

Selecting the Maintenance Type. To begin this substep, follow these steps:

1. From the "Establish Maintenance Parameters" menu, highlight option 1: "Select Maintenance Type."

2. Highlight "Select."

3. Press the "Enter" key.

Now, you will see a screen, as shown in Figure 66, that lists the component name in the left-most column and the maintenance task in the center column. The right-most column contains the current maintenance type, either corrective or preventative, for each maintenance action. Notice that for those components for which you marked multiple maintenance tasks, each task will be listed on a separate row of the screen. This includes the "OFFLINE" task.

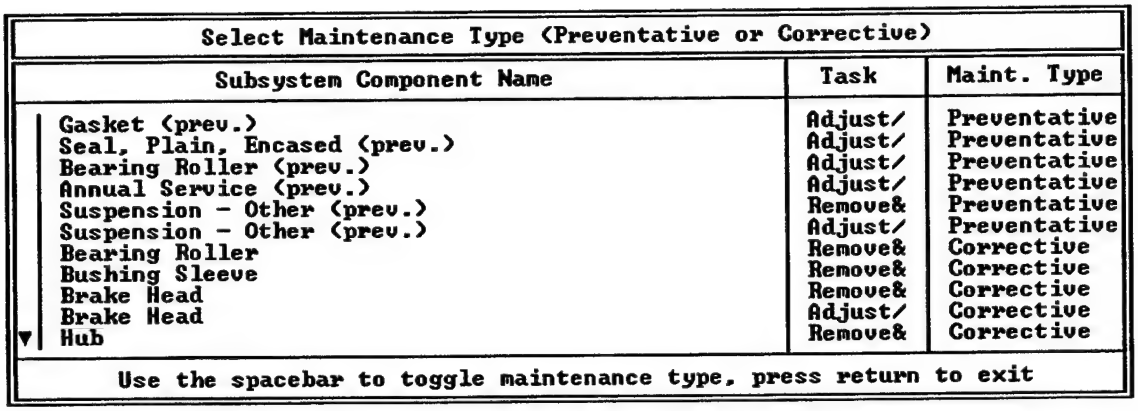


Figure 66. "Select Maintenance Type (Preventative or Corrective)" screen.

To change the maintenance type, follow these steps:

1. Highlight the maintenance action for which you want to change the maintenance type (example: "Gasket (prev.)").

2. Press the "space bar" to toggle the maintenance type.

3. Repeat Steps 1 and 2 until you are finished.

4. Press the "Enter" key.

Now, you should see the "Establish Maintenance Parameters" menu (see Figure 65).

Identifying the Maintenance Organization Level. In this substep, you will specify the organization level at which each maintenance action is most likely to be performed. Follow these steps:

1. From the "Establish Maintenance Parameters" menu, highlight option 2: "Identify Maintenance Organization Level."

2. Highlight "Select."

3. Press the "Enter" key.

The screen you should see now, in Figure 67, is very similar to the screen from which you selected the maintenance type, except that the right-most column contains the organization level. MMAA supports three organization levels: ORG, (or AVUM), DS, (or AVIM), and GS.

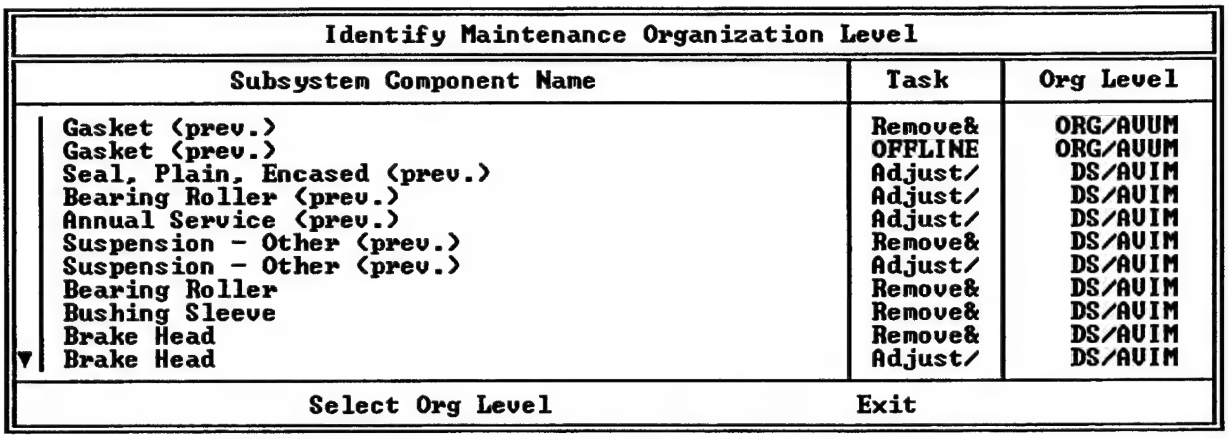


Figure 67. "Identify Maintenance Organization Level" screen.

If you have identified any off-line maintenance actions, you must select an organization level that is the same as or higher than the one you selected for the associated remove & replace maintenance action. For example, if you have said that the gasket is to be removed and replaced and is also to be maintained off line, and if you specify the remove & replace will be performed at the ORG level, then you can select ORG, DS, or GS for the off-line action. However, if you specify that the remove & replace will be done at the DS level, then you can only select DS or GS for the off-line action. MMAA will provide an error message if you try to assign the off-line maintenance to an organizational level that is below the level assigned for the associated remove and replace action.

Follow these steps to change the organization level for any of the maintenance actions listed:

1. Highlight the maintenance action for which you want to change the organization level.
2. Highlight "Select Org Level."
3. Press the "Enter" key.
4. On the small menu that is displayed now, highlight the organization level you want.
5. Press the "Enter" key.
6. Repeat Steps 1 through 4 until you are finished.
7. Highlight "Exit."

8. Press the "Enter" key.

You should see the "Establish Maintenance Parameters" menu (see Figure 65).

Identifying MOS, Skill Level, and Number of Soldiers who will Perform the Maintenance. Use this substep to identify who will perform each maintenance action. You can specify as many as two different MOSs to perform this task and any number of soldiers per MOS. Note that the model will assume that all the soldiers you specify will be required to perform the entire maintenance action and will all have to be available before the action can begin. If this is not the case, you should divide this maintenance action into two or more maintenance actions.

To identify the soldier(s) who will perform each maintenance action, follow these steps:

1. From the "Establish Maintenance Parameters" menu, highlight option 3: "Identify MOS, Skill Level, Number per Task."

2. Highlight "Select."

3. Press the "Enter" key.

Now, you should see a menu that has six columns as shown in Figure 68. As usual, the left-most column includes the component, and the second column contains the maintenance task. The remaining columns include the MOS, skill level, and number of soldiers for each MOS that will be needed to perform the maintenance action.

Identify MOS Skill Levels

Subsystem Component Name	Task	MOS #1	No.	MOS #2	No.
Gasket (prev.)	Adjust/	45L20	1		
Seal, Plain, Encased (prev.)	Adjust/	45L20	1		
Bearing Roller (prev.)	Adjust/	45L20	1		
Annual Service (prev.)	Adjust/	45L20	1		
Suspension - Other (prev.)	Remove&	45K20	1		
Suspension - Other (prev.)	Adjust/	45L20	1		
Bearing Roller	Remove&	45L20	1		
Bushing Sleeve	Remove&	45L20	1		
Brake Head	Remove&	45L20	1		
Brake Head	Adjust/	45L20	1		
Hub	Remove&	45L20	1		

MOS #1 No. MOS #1 MOS #2 No. MOS #2 Exit

Figure 68. "Identify MOS Skill Levels" screen.

Note that the format for the MOS or skill level is ##A##, in which the first three characters are the MOS and the last two characters are the skill level. The format for all MOSs is

two numbers and an alphabetic character (e.g., 63D, 47F, 63F). Skill levels are usually 10, 20, or 30. Therefore, examples of MOS-skill levels are 63D10, 47F20, 63F10. Be aware that this is case sensitive, so that 47F20 is not the same as 47f20.

If only one MOS is required to perform the maintenance action, you should leave the MOS 2 column blank.

To change the first MOS assigned to a maintenance action, follow these steps:

1. Highlight the maintenance action for which you want to change the first MOS (example: "Gasket (prev.)").

2. Highlight "MOS 1."

3. Press the "Enter" key.

4. Type the new MOS-skill level (example: "45L20").

5. Press the "Enter" key.

To change the numbers of soldiers of the first MOS who are assigned to a maintenance action, follow these steps:

1. Highlight the maintenance action for which you want to change the numbers of soldiers in the first MOS (example: "Gasket (prev.)").

2. Highlight "No. MOS 1."

3. Press the "Enter" key.

4. Type the new number (example: "1").

5. Press the "Enter" key.

To exit this substep, follow these steps:

1. Highlight "Exit."

2. Press the "Enter" key.

You should be at the "Establish Maintenance Parameters" menu (see Figure 65).

Identifying the Mean Operational Units Between Failure (MOUBF). You will identify failure rates for each maintenance action in this substep. To begin, follow these steps:

1. From the "Establish Maintenance Parameters" menu, highlight option 4: "Identify Mean Operational Units Between Failure."

2. Highlight "Select."

3. Press the "Enter" key.

Now, you will see a screen (see Figure 69) that lists the component name in the left-most column and the maintenance task in the center column. The right-most column contains the current units between failure for each maintenance action. Notice that for those components for which you marked multiple maintenance tasks, each task will be listed on a separate row of the screen.

Identify Mean Operational Units Between Failure

Subsystem Component Name	Task	Distance Between Failure
Gasket (prev.)	Remove&	1
Gasket (prev.)	OFFLINE	NA
Seal, Plain, Encased (prev.)	Adjust/	3494
Bearing Roller (prev.)	Adjust/	4717
Annual Service (prev.)	Adjust/	1387
Suspension - Other (prev.)	Remove&	5241
Suspension - Other (prev.)	Adjust/	5549
Bearing Roller	Remove&	2483
Bushing Sleeve	Remove&	3628
Brake Head	Remove&	786
Brake Head	Adjust/	4492

Select Operational Unit **Exit**

Figure 69. "Identify Mean Operational Units Between Failure" screen.

The top of the right-most column on this screen includes the units that apply to this subsystem. These units are time, rounds, or distance, depending upon the equipment group you specified for the subsystem.

To calculate a failure time for each corrective maintenance action, MMAA will use a random number to select a value from an exponential distribution for the mean that you enter. The value that is selected will determine the exact time during the simulation that each maintenance action will be required. Preventative maintenance actions are performed based directly on the failure time you enter. The exponential distribution is not used.

If you have identified any off-line maintenance actions, you will notice that the value for this action in the failure rate column is "NA." This is because the off-line action is associated with the remove & replace action for a component. Therefore, the off-line action is automatically performed when the remove & replace action is triggered. For this reason, the off-line action does not have a failure rate of its own.

To change the mean operational units between failure, follow these steps:

1. Highlight the value you want to change (example: "Gasket (prev.)").
2. Highlight "Select Operational Unit."
3. Press the "Enter" key.
4. Type the new mean operational unit between failure (example: "3500").
5. Press the "Enter" key.

To exit this substep, follow these steps:

1. Highlight "Exit."
2. Press the "Enter" key.

Now, you should be at the "Establish Maintenance Parameters" menu (see Figure 65).

Identifying the Mean Time to Repair. The mean time to repair determines how long it will take to perform each maintenance action. This time refers to elapsed time. If two soldiers are performing the repair and they work together for 1 hour to complete the repair, then the mean time to repair is 1 hour. In the MMAA reports, it will be reported that the repair took 2 maintenance man-hours because it took two soldiers 1 hour each.

To enter this substep, follow these steps:

1. From the "Establish Maintenance Parameters" menu, highlight option 5: "Identify Mean Time to Repair."
2. Highlight "Select."
3. Press the "Enter" key.

This menu is very similar to the menu you just used to identify the mean operational units between failure. On the command line you will see the "Select Time Units" command.

Follow these steps to change the time units:

1. Highlight "Select Time Units."
2. Press the "Enter" key.
3. Highlight minutes, hours, or days.
4. Press the "Enter" key.
5. At the "Would you like to convert existing MTTRs?" prompt type "Y."
6. Press the "Enter" key.

Now, you will notice the time units changed at the top of the right-most column of your screen. You should also notice that the values in the column were converted automatically.

To identify the mean time to repair, follow these steps:

1. Highlight the value you want to change (example: "Gasket (prev.)").
2. Highlight "Select Mean Time to Repair."
3. Press the "Enter" key.
4. Type the new mean time to repair (example: "1" hour).
5. Press the "Enter" key.

To exit this substep, follow these steps:

1. Highlight "Exit."
2. Press the "Enter" key.

Now, you should be back at the "Establish Maintenance Parameters" menu (see Figure 65).

Determining Mission Abort Status. The final substep on the "Establish Maintenance Parameters" menu is to determine whether the need for each maintenance action will cause the mission to abort.

Now, select this substep.

1. From the "Establish Maintenance Parameters" menu, highlight option 6: "Determine Mission Abort Status."

2. Highlight "Select."

3. Press the "Enter" key.

The screen displayed (see Figure 70) has a format that is consistent with the other screens you have seen in this MMAA step. The title of the right-most column is "Abort (%)." In this column, you will enter the probability that the need for a maintenance action will require the current mission to stop immediately for the repair to be performed. This probability should be between 0 and 100. If the system will be able to complete the current mission and can wait until the next scheduled maintenance period for the repair to be performed, then this column should have a "0" in it.

Select Mission Abort Status

Subsystem Component Name	Task	Abort (%)
Gasket (prev.)	Remove&	0
Gasket (prev.)	OFFLINE	NA
Seal, Plain, Encased (prev.)	Adjust/	0
Bearing Roller (prev.)	Adjust/	0
Annual Service (prev.)	Adjust/	0
Suspension - Other (prev.)	Remove&	0
Suspension - Other (prev.)	Adjust/	0
Bearing Roller	Remove&	20
Bushing Sleeve	Remove&	33
Brake Head	Remove&	50
Brake Head	Adjust/	50

Select Abort Percentage Exit

Figure 70. "Select Mission Abort Status" screen.

If you have identified any off-line maintenance actions, you will notice that the abort probability column will say "NA" for that action. This is because the off-line action is only triggered as a result of the associated remove & replace action.

To change the mission abort status, follow these steps:

1. Highlight the maintenance action for which you want to change the mission abort status (example: "Gasket (prev.)").

2. Highlight "Select Abort Percentage."

3. Press the "Enter" key.

4. Type the abort probability (example: "0").

5. Press the "Enter" key.

To exit this substep, follow these steps:

1. Highlight "Exit."

2. Press the "Enter" key.

Now, you should see the "Establish Maintenance Parameters" menu. You have just completed the data entry for this subsystem. Now return to the "Component and Maintenance Parameters" template.

1. Highlight "Save & Exit."

2. Press the "Enter" key.

When you are entering maintenance data for your system, you will need to use the "Parameters" command on this screen for each of the subsystems listed in the left-most column.

Now, return to the develop "Component Maintenance Parameters" menu.

1. Highlight "Save & Exit."

2. Press the "Enter" key.

You have just completed the second item on the "Develop Component Maintenance Parameters" menu (see Figure 57). Next, we will show you how to use the third menu item, "Compare Maintenance Parameters." In the third substep, you will be able to compare the entries for your new system to historical maintenance data from the MMAA libraries.

Comparing the Data from the Contractor's Design to Actual Maintenance Data from Existing Army Weapon Systems. The data you just entered will probably come from a contractor's design. The purpose of this step is to provide a means of comparing your entries with data that are in the MMAA maintenance library to determine whether there are any large discrepancies.

Now, select the third menu item.

1. From the "Develop Component Maintenance Parameters" menu, highlight option 3: "Compare Components and Parameters with Baseline."

2. Press the "Enter" key.

The screen you should see now has a lot of information on it, as shown in Figure 71. It is a spreadsheet-style screen, with a command bar on top. The top row of data for each maintenance action consists of the data you entered. The second row contains library data.

Edit Select Subsystem Access Library Compare Save & Exit
Bottom row of row pairs is baseline data

▼ System: Improved M-198 - A1 Subsystem: Suspension

Component Name Maintenance Task	Mnt Typ	Org Lev	MOS #1	No. #1	MOS #2	No. #2	MOUBF (Dist.)	MTTR (Hours)	Abt (%)
1. Gasket (prev.) Remove&	Cor	O/U	45L20	1			1	1.00	0
2. Gasket (prev.) OFFLINE	Cor	O/U	00A00	1			NA	1.00	NA
3. Seal, Plain, Encased Adjust/	Pre	D/I	45L20	1			3494	1.94	0
	Pre	D/I	45L20	1			3494	1.94	0
4. Bearing Roller (prev Adjust/	Pre	D/I	45L20	1			4717	1.58	0
	Pre	D/I	45L20	1			4717	1.58	0

Figure 71. Compare entered data with library data.

Each of the commands on the command bar is summarized below.

• Edit - You can use this command to change any of the values on the screen in the rows that apply to your system design (i.e., the top row for each maintenance action). Expert MMAA users can enter all the data using this command rather than going through the individual maintenance type, organization level, mean operational unit between failure, etc., substeps.

• Select Subsystem - Use this command to display the data from a different subsystem. Notice that the subsystem name is on the top row of this screen.

• Access Library - Since the purpose of this screen is to compare the contractor's design maintenance data with data from existing Army weapon systems, each maintenance action has two rows of data next to it. The top row contains the contractor information you just entered. The bottom row should contain actual maintenance data from the library of existing weapon

systems data. Since you chose an existing system from the library to use in this tutorial, the second row should already be full of information. For a new system, you would use the "Access Library" command to search the library for similar systems and copy those systems into the second row for each maintenance action in the spreadsheet.

• Compare - You will use this command to automatically compare the top row for each maintenance action in the spreadsheet to the second row. The comparison will proceed automatically until it finds a discrepancy between the data you entered and the existing data you copied in from the library using the "Access Library" command. When MMAA finds a discrepancy, you will be able to ignore it or change it.

This screen has 10 columns. The contents of these are summarized below.

• Component Name Maintenance Task - This column contains the name of the maintenance actions for the subsystem.

• Mnt Typ (Maintenance Type) - This column indicates whether the maintenance action is a corrective (Cor) or preventative (Pre) repair action.

• Org Lev (Organization Level) - This column indicates whether the repair will be performed at the Org-AVUM (O/U) maintenance organization level, the DS-AVIM (D/I) level, or the GS (GS) level.

• MOS #1 - This column contains the MOS of the soldier(s) that will perform the maintenance action.

• No. #1 - The number of soldiers of MOS #1 needed to perform the maintenance action.

• MOS #2 - If more than one MOS is required to perform the maintenance action, this column will contain the second MOS needed.

• No. #2 - The number of soldiers of MOS #2 needed to perform the maintenance action.

• MOUBF (Mean Operational Units Between Failure) - This column contains the failure rates for each maintenance action. MMAA uses these rates as the mean of an exponential distribution to calculate a failure time for each action.

• MTTR (Mean Time to Repair) - This column contains the time it will take to perform each maintenance action.

• Abt Sta (Abort Status) - This final column contains the probability that the need for each maintenance action will cause the current mission to abort.

Each maintenance action is associated with two rows of data in the spreadsheet. The top row contains data you entered for your current weapon system. The data in the bottom row contain MMAA maintenance library data.

Editing Values in the Spreadsheet. Follow these steps to use the "Edit" command:

1. Highlight "Edit."

2. Press the "Enter" key.

3. Use the arrow keys to move the highlight to a spreadsheet cell in which you want to change the entry.

4. Press the "Enter" key.

If you chose to change either a maintenance type or an abort status, then the value will have been changed automatically when you pressed "Enter." If you chose one of the other parameters, then you should follow these steps:

1. Type the new value.

2. Press the "Enter" key.

To leave the "Edit" command, press the "Escape" key.

Using the Compare Command. To use the "Compare" command, follow these steps:

1. Highlight "Compare."

2. Press the "Enter" key.

MMAA will automatically compare each pair of cells to find any discrepancies between the data you entered and the data in the bottom row of each maintenance action. When it finds a

1. Highlight "Save & Exit."

2. Press the "Enter" key.

You should now see the "Develop Component Maintenance Parameters" menu (see Figure 57). You have completed the three substeps on this menu. To return to the MMAA step menu,

1. Highlight "Exit."

2. Press the "Enter" key.

Step 2: Develop maintenance scenario. In Step 1, you entered the characteristics of the hardware involved in your system design. Use this second step to enter a variety of scenarios under which you want to model the maintenance requirements of your system design.

To begin the second step from the MMAA step menu (see Figure 56), follow these steps:

1. From the MMAA step menu, highlight option 2: "Develop Maintenance Scenario."

2. Press the "Enter" key.

You should now see a screen that lists the existing maintenance scenarios (see Figure 72). You can have several maintenance scenarios for each system. Each one uses the same maintenance actions but exercises the system under different usage rates, mission lengths, maintenance periods, and manpower pools.

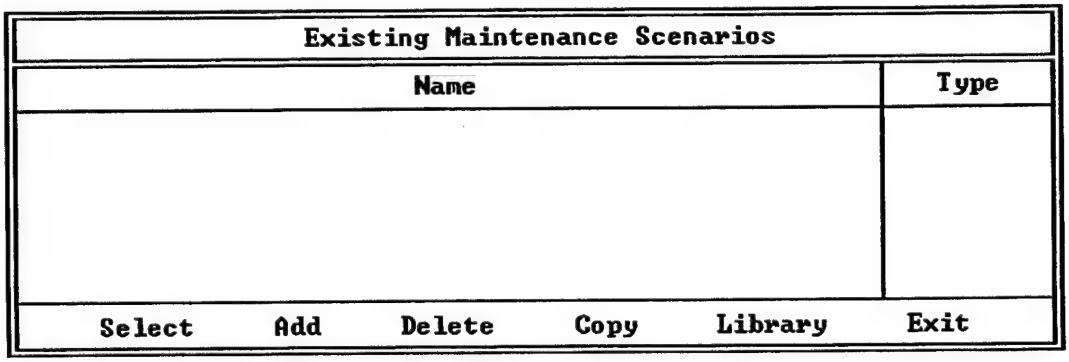


Figure 72. "Existing Maintenance Scenarios" screen.

From this screen, you can select an existing maintenance scenario and modify its values, or you can add a new one. You can also use the "Library" command to search the library for scenarios that are entered for existing systems and copy those into your system.

To add a new scenario, follow these steps:

1. Highlight "Add."
2. Press the "Enter" key.
3. Type a scenario name (example: "30 days of missions").
4. Press the "Enter" key.

Now, the new scenario will have been added to the list on the screen. To select that scenario, follow these steps:

1. Highlight your new scenario (example: "30 days of missions").
2. Highlight "Select."
3. Press the "Enter" key.

You should now see the "Develop Maintenance Scenario" menu (see Figure 73).

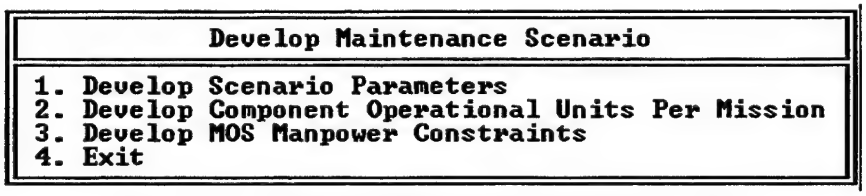


Figure 73. "Develop Maintenance Scenario" menu.

This step has three substeps which are listed on the menu and summarized below.

• Develop Scenario Parameters - In this substep, enter the simulation time span, the average mission length, the standard deviation of the mission length, and the time between missions. Also enter whether you want to resume an aborted mission after the maintenance is complete. The values you choose for each of these parameters will greatly affect the RAM performance of your system.

• Develop Component Operational Units Per Mission - In this substep, enter the number of rounds fired, distance traveled, and time operated per mission for your system. The values

you choose for each of these parameters will greatly affect how often each maintenance action is required.

• Develop MOS Manpower Constraints - In this substep, enter the number of soldiers available to perform maintenance in each MOS at each organization level. The values you choose in this substep will greatly affect how long it will take to repair your system if multiple maintenance actions have to be performed at once.

Now, choose the first substep.

1. Highlight "Develop Scenario Parameters."

2. Press the "Enter" key.

The screen displayed has five items on it, as shown in Figure 74.

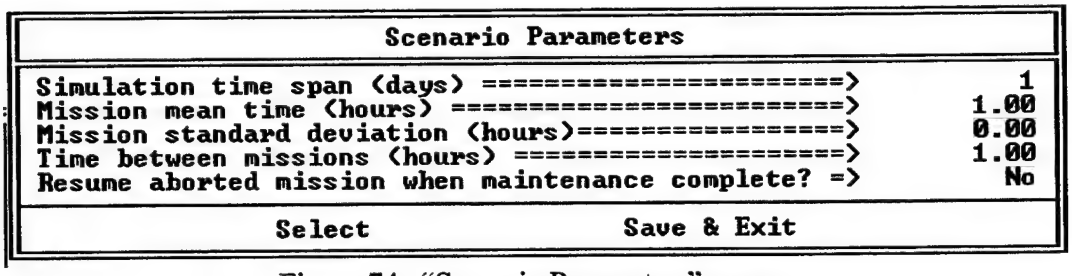


Figure 74. "Scenario Parameters" screen.

The instructions for changing the parameters are given below.

Changing the Simulation Time Span. The first item on the "Scenario Parameters" screen is the "Simulation Time Span." This value is the number of days of system missions and maintenance actions that you want to model. If you enter a large value here, it will take longer to run your simulation model, but you will be able to collect more data.

We recommend that the first time you run your mission, you run at least 100 missions. So, if your system will operate for one mission per day, that would mean you should enter a simulation time span of 100 days. Then, when you view the results of your model run, you can determine whether you got a representative sample of maintenance actions.

To change the simulation time span, follow these steps:

1. Highlight "Simulation time span (days)."

2. Highlight "Select."

3. Press the "Enter" key.

4. Type a new simulation time span (example: "30").

5. Press the "Enter" key.

Changing the Mission Mean Time and Standard Deviation. The second item on the "Scenario Parameters" screen is the "Mission mean time." This value is in hours and is the length of your system's average mission. To change the mission mean time, follow these steps:

1. Highlight "Mission mean time (hours)."

2. Highlight "Select."

3. Press the "Enter" key.

4. Type a new mission mean time (example: "2").

5. Press the "Enter" key.

You can use the third item on the menu, "Mission Standard Deviation," to enter the amount of variability that will be likely in your mission length. If you are not sure how to estimate a standard deviation, then you can follow this simple rule. Nearly all of your missions will be within three standard deviations above and below your mean. For example, if you enter a mean of 10 and a standard deviation of 1, nearly all of your mission times will be between 7 and 13 hours. Most of your mission times will be close to 10.

To change the mission standard deviation, follow these steps:

1. Highlight "Mission standard deviation (hours)."

2. Highlight "Select."

3. Press the "Enter" key.

4. Type a new mission standard deviation (example: ".5").

5. Press the "Enter" key.

Changing the Time Between Missions. As we discussed earlier, all maintenance actions are performed between missions. The last item on this screen controls the amount of time

available to perform any needed maintenance actions. If this time is not sufficient, then your system will miss the next mission because it will still be in maintenance. This will be shown as a low availability value in the reports you will see in Step 4 of MMAA.

To change the time between missions, follow these steps:

1. Highlight "Time between missions (hours)."
2. Highlight "Select."
3. Press the "Enter" key.
4. Type a new time between missions (example: "4").
5. Press the "Enter" key.

Changing the Resume Aborted Missions when Maintenance Complete. If a component fails and the abort probability indicates that the mission will abort as a result of that failure, the system leaves the mission immediately and is placed in maintenance. If the "Resume aborted mission when maintenance complete" parameter is "Yes," then in that maintenance period we fix only the component that aborted the mission, and then we return to the mission. If the mission aborts a second time, we follow the same procedure, always returning to the unfinished mission. This continues until the system has been in the mission for the entire mission performance time (as specified in the mean and standard deviation).

In other words:

if
the "resume" parameter is "yes"
and
a component fails after 1 hour of a 2-hour mission
and
that failure causes a mission abort
and
the repair takes 30 minutes
and
no other failures occur
then
the mission will complete 2.5 hours after it originally began.

Now, if the "Resume aborted mission when maintenance complete" parameter is "No," we fix all failures that have occurred before the mission aborted, and then we wait for the next regularly scheduled mission before we return the system to a mission.

To change "resume aborted mission when maintenance completes," follow these steps:

1. Highlight "Resume aborted mission when maintenance complete?"
2. Highlight "Select."
3. Press the "Enter" key.

Notice that the value for this parameter toggled.

You have now finished entering the scenario parameters. Follow these steps to save your changes and return to the "Develop Maintenance Scenario" menu:

1. Highlight "Save & Exit."
2. Press the "Enter" key.

Developing the Component Operational Units Per Mission. You should now see the "Develop Maintenance Scenario" menu (see Figure 73). The second item on this menu is "Develop Component Operational Units Per Mission." Select this menu item.

1. From the develop maintenance scenario menu, highlight option 2: "Develop Component Operational Units Per Mission."
2. Press the "Enter" key.

The purpose of this menu item (see Figure 75) is to enable you to enter the number of rounds your system will fire, the distance it will travel, or the hours it will operate during each mission. These entries are then used to determine when each maintenance action will be needed.

Component Operational Units Per Mission		
Parameter	Unit Metric	Operational Units Per Mission
Armament1	rounds	1.00
Armament2	rounds	1.00
Armament3	rounds	1.00
Armament4	rounds	1.00
Armament5	rounds	1.00
Armament6	rounds	1.00
Armament7	rounds	1.00
Mobility	distance	1.00
Other	hours	1.00
Select Operational Unit		Save & Exit

Figure 75. "Component Operational Units per Mission" screen.

To change the operational units your system will use each mission, follow these steps:

1. Highlight the value you want to change.
2. Highlight "Select Operational Unit."
3. Press the "Enter" key.
4. Type the new value.
5. Press the "Enter" key.

When you have changed all the values to represent your system, save your changes and exit this screen by following these steps:

1. Highlight "Save & Exit."
2. Press the "Enter" key.

Now, you should see the "Develop Maintenance Scenario" menu (see Figure 74).

Developing MOS Manpower Constraints. You will use this step to limit the number of soldiers you have available in each MOS at each organization level. This step is optional. If you do not enter any constraints, then the MMAA model will assume that the manpower pool is unlimited and will maximize the availability of your system by performing all the maintenance actions at once. If you do enter constraints, then MMAA will schedule maintenance actions so that they can be performed within the constraints. Usually, this means that maintenance actions that use the same MOS will be performed in serial, rather than parallel, efforts.

We recommend that the first time you execute your maintenance model you leave the manpower unconstrained. Then, when you review your reports, you will see the number of soldiers in each MOS who were used in the unconstrained model. If, at that time, you want to study the effects of reducing the manpower availability, you should return to this substep and enter manpower constraints.

Select this substep.

1. From the "Develop Maintenance Scenario" menu, highlight option 3: "Develop MOS Manpower Constraints."

2. Press the "Enter" key.

Now, you will see a small screen that has four columns, as shown in Figure 76. The left-most column lists all the MOSs that have been assigned to maintenance actions in your system. The remaining three columns either contain the word "None," or they contain numbers that represent the numbers of soldiers in each MOS at each of the three organization levels.

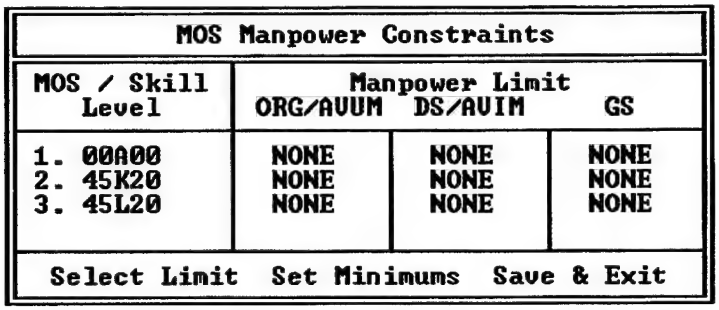


Figure 76. "MOS Manpower Constraints" screen.

Follow these steps to change the limit:

1. Highlight the MOS whose limit you want to change.

2. Highlight "Select Limit."

3. Press the "Enter" key.

4. Type the limit for this MOS at the ORG/AVUM level.

5. Press the "Enter" key.

6. Type the limit for this MOS at the DS/AVIM level.

7. Press the "Enter" key.

8. Type the limit for this MOS at the GS level.

9. Press the "Enter" key.

MMAA will not allow you to enter manpower constraints that are unrealistic for your system. For example, if you have a maintenance action that requires two soldiers who have an MOS of 63D10, then you will not be able to constrain the 63D10 manpower at fewer than two soldiers. To set an MOS to the minimum acceptable limit, follow these steps:

1. Highlight an MOS (Example: "45K20").

2. Highlight "Set Minimums."

3. Press the "Enter" key.

When you are finished entering manpower limits, follow these steps:

1. Highlight "Save & Exit."

2. Press the "Enter" key.

You have now finished entering your maintenance scenario. You are now ready to run your MMAA maintenance model. Follow these steps to return to the MMAA step menu (see Figure 56):

1. From the "Develop Maintenance Scenario" menu, highlight option 4: "Exit."

2. Press the "Enter" key.

The MMAA step menu is displayed.

Step 3: Execute maintenance simulation. In this step, MMAA will use the data in the scenario you have chosen, as well as the data associated with your system's maintenance actions to build and execute a simulation model. This step is fully automatic. All you need to do is select the maintenance scenario that you want MMAA to model.

To begin this step, follow these steps:

1. From the MMAA step menu, highlight option 3: "Execute Maintenance Simulation."

2. Press the "Enter" key.

From the screen you should see now (Figure 77) you can select one of the maintenance scenarios for your existing system.

Select Scenario to Execute	
Name	**Type**
30 days of missions	**USER**
Select **Exit**	

Figure 77. "Select Scenario to Execute" menu.

To select a scenario, follow these steps:

1. Highlight "Select."

2. Press the "Enter" key.

When the model is running, a screen titled "Executing Maintenance Model" will display, as shown in Figure 78. This screen shows you an estimate of when the model will complete. If you need to interrupt execution, you can press "q" to abort the execution. Any results that have compiled until the time you pressed "q" will be saved and you will be able to display them in the next MMAA step.

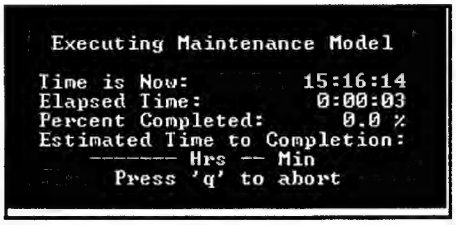


Figure 78. "Executing Maintenance Model" screen.

When the model execution is complete, a summary screen will display that includes the results of your model. Each item on this screen is discussed next.

• Total Maintenance Manhour Requirements - This lists the number of maintenance man-hours (preventative and corrective) that were used repairing your system during the maintenance simulation. The maintenance man-hours are reported by maintenance organization level.

• Total Number of Preventative Maintenance Tasks - This value is the total number of preventative maintenance actions that were performed during your maintenance simulation.

• Total Number of Corrective Maintenance Tasks - This value is the total number of corrective maintenance actions that were performed during your maintenance simulation.

• Maximum Maintenance Headcount - This item lists the maximum number of soldiers that were needed at each organization level during any one maintenance period.

• Simulation Execution Time - This value tells you how long it took to execute your maintenance simulation.

This summary of information is also available in the next step, as a report to analyze. When you are finished reviewing the information, press any key to return to the MMAA step menu (see Figure 56).

Step 4: Analyze simulation results. In this step, you can view and print 11 different reports that provide information regarding how your system performed. Follow these steps to begin your analysis:

1. From the MMAA step menu, highlight option 4: "Analyze Simulation Results."
2. Press the "Enter" key.

From the screen displayed, you can select one of the maintenance scenarios for your existing system (see Figure 79).

To select a scenario, follow these steps:

1. Highlight "Select"
2. Press the "Enter" key.

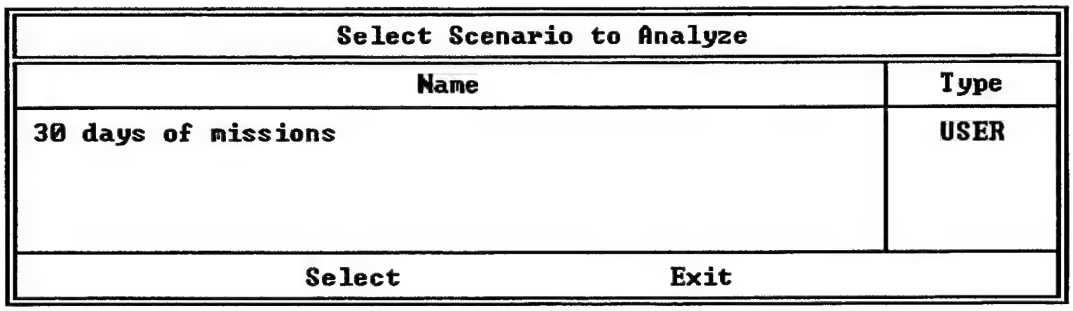


Figure 79. "Select Scenario to Analyze" menu.

Now, you should see a list of 12 options, as shown in Figure 80.

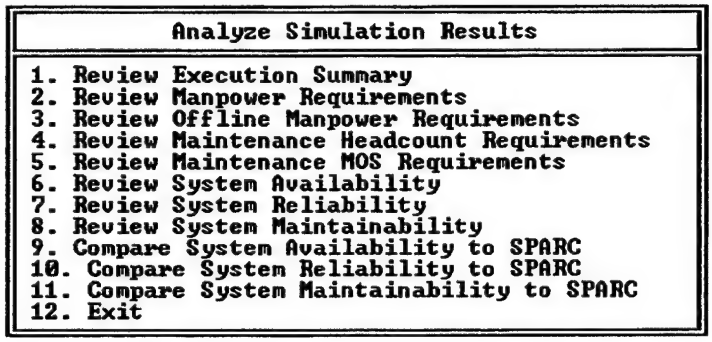


Figure 80. "Analyze Simulation Results" menu.

To view any of these reports, follow these steps:

1. Highlight a report.

2. Press the "Enter" key.

The contents of each of the 11 reports listed are summarized next.

1. Execution Summary. This report contains the same information that was displayed when your simulation run completed. You can use the "Print" command at the bottom of the report to output a hard copy of the information.

2. Manpower Requirements. This report is a complete list of each maintenance action that was performed, who performed it, and how long it took. This report is presented in a spreadsheet format, and you can use the arrow keys to scroll the information. The top of the report has a command line. Along with the "Print" and "Exit" commands, there is a "Sort" command.

The columns of the report, from left to right, are the subsystem name, the component name, the name of the maintenance task, the MOS that performed the maintenance, the organizational level at which the maintenance was performed, the maintenance type (preventative or corrective) and the number of times the maintenance action was performed. The final column provides the total number of man-hours spent on this maintenance action.

You can use the "Sort" command to reorder the information in the report. For example, if you sort the information by MOS, then all repair actions performed by each MOS will be grouped together.

3. Off-line Manpower Requirements. This report is a list of all the off-line maintenance actions that were performed. This report is a subset of the second report, described previously. Along with each off-line maintenance action listed, the reports lists who performed it and how long it took. This report is presented in a spreadsheet format, and you can use the arrow keys to scroll the information. The top of the report has a command line. Along with the "Print" and "Exit" commands, there is a "Sort" command.

You can use the "Sort" command to reorder the information in the report. For example, if you sort the information by MOS, then all off-line repair actions performed by each MOS will be grouped together.

4. Maintenance Headcount Requirements. This report is a frequency histogram of the numbers of soldiers needed in each MOS throughout the maintenance simulation. For example, if your system has a 1-hour mission, then MOS 63D20 performs a 1-hour maintenance action; the headcount requirement for 63D20 will show that 50% of the time 0 soldiers were needed, and 50% of the time 1 soldier was needed. The values of each bar in the histogram will be displayed at the top of the bar.

This frequency histogram is very useful if you are interested in constraining your manpower pool. It will show you how often you needed various numbers of soldiers.

The commands at the bottom of the report enable you to change MOSs, change organization levels, and to print the histograms, either separately or as a set.

5. Maintenance MOS Requirements. This report provides the maintenance man-hours that were required by each MOS at each organizational level. The values on this report are also

included on "Manpower Requirements" report (No. 2); however, in this report, they are formatted differently.

6. System Availability Report. This report tells you the average amount of time your system went between failures and the average amount of time it took to perform a maintenance action. In addition, the report lists your system's inherent and achieved availability. Inherent availability is calculated as follows:

Inherent Availability = MTBF / (MTBF + MTTR)

where

MTBF = Mean time between component failures
MTTR = Mean time to repair

Readiness is calculated as the percentage of missions that your system could begin when they were scheduled. If your system missed a mission because the maintenance actions were not complete, then readiness will be reduced. If your mission has a readiness of 100%, then it never missed a mission.

"Good" Time/Overall Time is the proportion of time your system was out of maintenance and mission ready.

7. System Reliability Report. This report tells you how many missions your system started, how many it completed, and how many it aborted. If a maintenance action that led to mission abort was needed, then the mission abort count will be incremented.

In addition, this report has ten separate measures of reliability. The first measure, mission reliability, is on the bottom left side of the screen. This value is the percentage of missions that were not aborted.

Mission Reliability = Missions Completed/Missions Started

The remaining measures of reliability are the equipment group reliabilities. These values are the percentage of missions that completed without need for a maintenance action in that equipment group. For example, if the Armament1 Reliability were reported as 60%, then that would mean that 40% of the missions that your system started had failures in Armament1 subsystems when they completed.

8. System Maintainability Report. This report presents the maintenance ratio for each subsystem. The maintenance ratio is the number of maintenance man-hours per operational hour. The maintenance ratio is calculated during the maintenance simulation.

The remaining reports compare the results of the maintenance simulation model to the minimum acceptable RAM requirements established by SPARC, one of the HARDMAN III Products. You can import the results of a SPARC analysis into MAN-SEVAL using the "Perform Utilities" option on the MAN-SEVAL main menu. For more information regarding how you use this import utility, refer to Section 7 of this User's Manual.

9. Compare System Availability to SPARC Report. SPARC does not report or estimate achieved availability (or readiness); however, it does report inherent and operational availability. As discussed in the System Availability report (No. 6), MMAA reports inherent and achieved availability.

This report shows all the availability measures. If the MMAA values do not meet the SPARC requirements, they will be marked with asterisks.

10. Compare System Reliability to SPARC Report. This report compares the equipment group reliabilities. These are the Mean units between failure for the mobility, armaments, and other equipment groups. If the MMAA values do not meet the SPARC requirements, they will be marked with asterisks.

11. Compare System Maintainability to SPARC Report. This report compares the subsystem maintenance ratios. If you have not imported SPARC comparison data, you will not be able to view this report. The MMAA maintainability data are contained in the System Maintainablity report (No. 8).

If you have entered SPARC comparison data, all your system's subsystems that do not meet the SPARC requirements will be marked with asterisks.

At the bottom of each report is a "Print" command. If you print a report and the lines and borders are replaced by alphabetic characters, then your printer is not an IBM graphics compatible printer, and you must use the utilities program to specify the correct printer. For further information, use the "F1" HELP command in Perform Utilities or refer to Section 7 of this User's Manual.

Follow these steps to return to the MMAA step menu:

1. Highlight "Exit."

2. Press the "Enter" key.

This completes the steps on the MMAA step menu, so you have completed the second portion of the tutorial. To exit MMAA,

1. From the MMAA step menu, highlight option 5: "Exit."

2. Press the "Enter" key.

The MAN-SEVAL main menu is displayed (see Figure 1). Now you have completed the two portions of the tutorial.

EXITING MAN-SEVAL

To exit MAN-SEVAL, follow these steps:

1. From the MAN-SEVAL main menu, highlight option 4: "Exit."

2. Press the "Enter" key.

This closes MAN-SEVAL. Now you have completed the entire tutorial including the MMAA and WAA steps and the explanation of MAN-SEVAL.

SECTION 6 - RECOMMENDED STRATEGY FOR USING MAN-SEVAL

As stated in the previous section, we recommend that you proceed through MAN-SEVAL in the same order as the steps listed on the MAN-SEVAL main menu. In addition, we recommend that you copy data from the MAN-SEVAL library when appropriate. Doing so will make your job much easier and will reduce the amount of "guess work" you have to do.

Finally, if you find that your MAN-SEVAL mission is getting so large that it is difficult to remember what is happening, you should consider breaking it into several smaller pieces. Each of these pieces can be its own mission. These smaller missions run much faster during execution and will be easier to analyze.

SECTION 7 - HELP SYSTEM AND UTILITIES

In this section we discuss the HELP system and utilities that are included in MAN-SEVAL. The HELP facility is designed to answer most of the questions that are likely to occur to you while you are using MAN-SEVAL. The utilities can be accessed by choosing the third option "Perform Utilities" on the MAN-SEVAL main menu. Each option is described later in this section.

HELP SYSTEM

To use HELP, press "F1" at any time. You will see a single screen of explanations concerning the information on the screen you were just viewing. Since there are many different HELP screens and most of them are quite long, some messages may take a few seconds to display in their entirety. Please be patient.

You will notice that at the bottom of the HELP screen there is a message regarding how you can get a HELP message containing data sources and the MAN-SEVAL glossary. If you have questions regarding the source of any data that are presented on the screen, press "D." If you are at a place in MAN-SEVAL where the data source HELP is not appropriate (probably because you have entered the data yourself or because the menu does not have data attached to it), you will see a message that says the data sources are not available. If you have questions regarding any of the acronyms that are used in MAN-SEVAL, press "G." You will then see the MAN-SEVAL glossary.

When you want to leave HELP and return to your work in MAN-SEVAL, press any key.

UTILITIES

A brief explanation of each of the utilities in MAN-SEVAL is included here. If you have additional questions about these utilities, please use the "F1" command to ask for HELP from within each option on the "Perform Utilities" menu in MAN-SEVAL. The explanations there are more extensive.

- Change Settings - Use this utility to change the menu colors, to put your files in different directories, and to change the type of printer to which you want to send your printed reports. Remember that if you change the directories, you must also move the files. MAN-

SEVAL will not do this for you. To move files from one directory to another, use the DOS "copy" command. An explanation of this command is provided in your DOS manual.

• Compress Working Databases - Use this utility to compress the working data bases to recover any space that was left when working data were deleted. Essentially, this removes the "holes" in your data base and makes it smaller and more efficient.

• Import data from another MMAA to this MMAA - Use this utility to move MMAA maintenance data and scenarios from one computer to another. For instance, if your co-worker has built a MMAA description and scenario and you want a copy of it, ask him or her to use the "Export MMAA Data" utility on their version of MAN-SEVAL, and it will be written on a disk. Then you can take the disk to your computer and use this utility to "Import" it into your working data base.

When you first select this utility, MAN-SEVAL will ask you to select the letter of the drive on which the MMAA data you want to import are written. This will probably be one of your floppy disk drives, although it could also be your hard disk. MAN-SEVAL will then show you the files on the disk. If the file you are importing is the only one on the disk, that file will be highlighted. If there are other files, use your up or down arrow key to select the correct file and press "Enter." MAN-SEVAL will read the first part of the file to see whether that system already exists in your current MMAA library or working file. If it already exists, MMAA will not allow you to import the system because you would lose the existing data. In that event, MMAA will ask you to change either the system name or version name of the system you are importing. Once you change that information, the import will proceed.

After the import is complete, you can enter MAN-SEVAL through the "Resume Work on Existing System" option on the main menu. You will see your imported system and version on the "Existing Systems" screen.

• Import data from another WAA to this WAA - Use this utility to move WAA missions from one computer to another. For instance, if your co-worker has built a WAA mission description and you want a copy of it, ask him or her to use the "Export WAA Data" utility on that version of MAN-SEVAL, and it will be written on a disk. Then you can take the disk to your computer and use this utility to "Import" it into your working data base.

When you first select this utility, MAN-SEVAL will ask you to select the letter of the drive on which the WAA data you want to import are written. This will probably be one of your floppy disk drives, although it could also be your hard disk. MAN-SEVAL will then show you the files on the disk. If the file you are importing is the only one on the disk, that file will be highlighted. If there are other files, use your up or down arrow key to select the correct file and press "Enter." MAN-SEVAL will read the first part of the file to see whether that system already exists in your current WAA library or working file. If it already exists, WAA will add the missions you are importing to the ones that already exist for that system. If the system does not exist, you will be able to either create a new system and import the data into that new system, or you will be able to select one of the existing systems and add the imported WAA missions to that existing system.

After the import is complete, you can enter MAN-SEVAL through the "Resume Work on Existing System" option on the main menu. You will see your new missions after you select the system into which you chose to import the data.

• Export data from this MMAA to another MMAA - Use this utility to move MMAA data from one computer to another. For instance, if you have entered maintenance data and scenarios that you want to share with a co-worker, use this command to "Export" a copy of it to a disk. Then your co-worker can use the "Import MMAA Data" utility in his or her version of MAN-SEVAL to add the data to his or her working data base.

When you select this utility, MAN-SEVAL will ask you to select the system for which you want to export data. Then, MAN-SEVAL will ask you to select the letter of the drive to which you want to export the file. You will probably select the letter that designates one of your floppy drives (either "A" or "B"), but you could also designate your hard drive. Once you have selected the drive letter, press "Enter" and follow the screen instructions. You will see a screen marked "--done--," press "Enter." MAN-SEVAL will show you another screen with the drive letter you selected and the default filename (A:\MAINT.IEF). You can press "Enter" to accept this filename or enter your own filename after the drive designation (e.g., PATRIOT.MAA) and press "Enter." When the export completes, it will have placed a filenamed MAINT.IEF or the file you named on the drive you designated. This can then be taken to another machine for import.

You do not have to execute the MMAA simulation before you export the data. The results of the simulation are not included in the export file. Also, you can only export one

MMAA system at a time. Since the export files are all named the same thing, you will have to use separate floppy disks (one per system) if you want to export multiple systems.

• Export data from this WAA to another WAA - Use this utility to move WAA missions from one computer to another. For instance, if you have built a WAA model that you want to share with a co-worker, use this command to "Export" a copy of it to a disk. Then your co-worker can use the "Import WAA Data" utility in his or her version of MAN-SEVAL to add the data to his or her working data base.

When you select this utility, MAN-SEVAL will ask you to select the system for which you want to export data. Then, MAN-SEVAL will ask you to select the mission you want to export. Finally, MAN-SEVAL will ask you to select the letter of the drive to which you want to export the file. You will probably select the letter that designates one of your floppy drives (either "A" or "B"), but you could also designate your hard drive. Once you have selected the drive letter, press "Enter" and follow the screen instructions. You will see a screen marked "--done--," press "Enter." MAN-SEVAL will show you another screen with the drive letter you selected and the default filename (A:\WERKLODE.IEF). You can press "Enter" to accept this filename or enter your own filename after the drive designation (e.g., PATRIOT.WAA) and press "Enter." When the export completes, it will have placed a filenamed WERKLODE.IEF or the file you named on the drive you designated. This can then be taken to another machine for import.

You do not have to execute the WAA simulation before you export the data. The results of the simulation are not included in the export file. Also, you can only export one WAA mission at a time. Since the export files are all named the same thing, you will have to use separate floppy disks (one per mission) if you want to export multiple missions.

• Import SPARC Comparison Data - Remember that the MAN-SEVAL tool determines whether your system design is likely to meet the SPARC performance requirements within the crew size constraints. Use this utility to automatically import the system and mission performance requirements data that were developed using SPARC. For instance, if you or a co-worker has performed an analysis of your system using SPARC, then you can use the "Export Data" utility in SPARC to put a copy of that analysis on a floppy disk. Then, you can use this utility to bring those data into MAN-SEVAL. MAN-SEVAL will then show you the files on the disk. If the file you are importing is the only one on the disk, that file will be highlighted. If there are other files, use your up or down arrow key to select the correct file and press "Enter."

• Import MMAA and WAA data from PERSEVAL - In this utility, MAN-SEVAL will accept MMAA and WAA data from the PER-SEVAL product. PER-SEVAL is used to determine whether the new system can be operated and maintained by the qualities of soldiers likely to be available when the system is fielded. The data used for that assessment can then be sent to MAN-SEVAL to ensure that the system can be operated and maintained by the quantities of soldiers likely to be available when the system is fielded.

To use this utility, you should have created the data using the export utility in PER-SEVAL. You will need to know the name of the export file. MAN-SEVAL asks you to select the drive. Highlight the drive of your export file and press "Enter." If the file you are importing is the only one on the disk, that file will be highlighted. If there are other files, use your up or down arrow key to select the correct file and press "Enter."

If the system already exists in the MAN-SEVAL data base, the same rules apply as in the "Import MMAA" and "Import WAA" utilities, and you will have to change the name of the system you are importing into MAN-SEVAL. If the system does not exist, you will still have the opportunity to rename the new system.

• Export MMAA and WAA data to PERSEVAL - In this utility, MAN-SEVAL will prepare MMAA and WAA data for import into the PER-SEVAL product. MAN-SEVAL is used to determine whether the new system can be operated and maintained by the quantities of soldiers likely to be available when the system is fielded. The data used for that assessment can then be sent to PER-SEVAL to ensure that the system can be operated and maintained by the qualities of soldiers likely to be available when the system is fielded.

First, MAN-SEVAL will ask you to select the drive letter for where you want the export data to be written (e.g., "A" or "B"), but you could also designate your hard drive. Once you have selected the drive letter, press "Enter" and follow the screen instructions. You will see a screen marked "--done--," press "Enter." MAN-SEVAL will show you another screen with the drive letter you selected and the default filename (A:\PERSEVAL.IEF). You can press "Enter" to accept this filename or enter your own filename after the drive designation (e.g., PATRIOT.PSV) and press "Enter." When the export completes, it will have placed a file named PERSEVAL.IEF or the file you named on the drive you designated. This can be taken to another machine for import.

You do not need to execute the models before exporting them to PER-SEVAL. The results of the model runs are not exported.

- Backup MMAA Library Database - Use this command to make backups of your MMAA libraries. This is for "safety's sake" and you should always have a backup stored in case your computer has a system failure.

- Backup MMAA Working Database - Use this command to make backups of your MMAA libraries. This is for "safety's sake" and you should always have a backup stored in case your computer has a system failure.

- Backup WAA Library Database - Use this command to make backups of your WAA libraries. This is for "safety's sake" and you should always have a backup stored in case your computer has a system failure.

- Backup WAA Working Database - Use this command to make backups of your WAA libraries. This is for "safety's sake" and you should always have a backup stored in case your computer has a system failure.

- Restore MMAA Library Database - If you should ever need to update or replace your MMAA library, use this utility to put the new library on your computer.

- Restore MMAA Working Database - If you should ever need to update or replace your MMAA working files, use this utility to put the backup working files on your computer.

- Restore WAA Library Database - If you should ever need to update or replace your WAA library, use this utility to put the new library on your computer.

- Restore WAA Working Database - If you should ever need to update or replace your WAA working files, use this utility to put the backup working files on your computer.

- Clear Working Database - This utility deletes your entire working data base. Use EXTREME caution in exercising this utility.

• Delete Working System - Use this utility to delete a specific system's missions from your working data base. This does not affect the library data.

• Invoke DOS Shell - This utility provides a gateway to all DOS commands without leaving MAN-SEVAL. To return to MAN-SEVAL once you are in the DOS shell, type "EXIT."

• Build Disks - This utility will build the install disks. You can designate a drive (a or b) on which to build the disks. In order for this utility to work, the files "exe.pm," "wrk.pm," and "hlp.pm" must contain the correct locations of the associated files. You must edit these files and made any necessary changes.

• Show Versions - Use this utility to display the versions for your software and data bases. This is the same version screen you see when you enter MAN-SEVAL.

REFERENCES

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McCracken, J.H., & Aldrich, T.B. (1984). Analysis of selected LHX mission functions: Implications for operator workload and system automation goals (Technical Note ASI 479-024-84). Fort Rucker, AL: Anacapa Sciences, Inc.

GLOSSARY

HARDMAN III	Usually refers to the six software tools that were developed under the Army Research Institute's MANPRINT Methods Development Contract.
MAINTENANCE ACTIONS	The maintenance parameters that apply to each component-maintenance task pair that you identified when you assigned maintenance tasks to each component.
MANPRINT	Manpower and personnel integration. An Army program that advocates the analysis of manpower, personnel, and training issues in the earliest stages of the weapon system acquisition process.
MAN-SEVAL	Manpower-based System Evaluation Aid, Product 5 of the MANPRINT Methods Development Contract. Also referred to as Product 5 of HARDMAN III. Used to estimate the number of soldiers who will be necessary to operate and maintain a specific weapon system design.
M-CON	Manpower Constraints Estimation Aid, Product 2 of the MANPRINT Methods Development Contract. Also referred to as Product 2 of HARDMAN III. Used to predict the quantities of soldiers in each MOS who are likely to be available when a new weapon system is fielded.
Micro Saint	A PC-based discrete event simulation tool. This tool provides the simulation engine in SPARC, MAN-SEVAL, and PER-SEVAL.
MMAA	Maintenance Manpower Analysis Aid, contained in MAN-SEVAL. Used to estimate the number of soldiers in each MOS who will be required to maintain a specific new weapon system design.
MOS	Military Occupational Specialty. A classification system for soldiers within the Army.
P-CON	Personnel Constraints Estimation Aid, Product 3 of the MANPRINT Methods Development Contract. Also referred to as Product 3 of HARDMAN III. Used to predict the personnel characteristics that will constrain the population of soldiers who are likely to be available to man a new weapon system when it is fielded.
PER-SEVAL	Personnel-based System Evaluation Aid, Product 6 of the MANPRINT Methods Development Contract. Also referred to as Product 6 of HARDMAN III. Used to estimate the personnel characteristics that will be required to man a new weapon system design in order for it to perform its missions successfully.

RAM	Reliability, availability, and maintainability.
SPARC	System Performance and RAM Criteria Estimation Aid, Product 1 of the MANPRINT Methods Development Contract. Also referred to as Product 1 of HARDMAN III. Used to identify unambiguous performance criteria for weapon systems; these criteria are then used to build the Request for Proposal (RFP).
T-CON	Training Constraints Estimation Aid, Product 4 of the MANPRINT Methods Development Contract. Also referred to as Product 4 of HARDMAN III. Used to estimate what the training system for a new weapon system is likely to look like when that system is fielded. This analysis is intended to be performed before the RFP is developed.
WAA	Workload Analysis Aid, contained in MAN-SEVAL. Used to estimate the number of operators needed to operate a specific weapon system design in the early stages of weapon system acquisition. This analysis is based on the estimation of operator workload as the operators perform their missions.

INDEX

APPENDIX A

ERROR MESSAGES

ERROR MESSAGES

MESSAGE	WHAT IT MEANS	WHAT TO DO
Confirm Delete Instruction? (Y/N)	You have indicated that you want to delete data	Enter either "y" or "n" and press "Enter"
Continuous functions don't have decision types Hit any key to continue	You have highlighted a continuous function and "Decision Type" and pressed "Enter." Continuous functions are not linked into the mission network	Press any key to continue, then highlight a different function
Continuous functions have no following functions! Hit any key to continue	You have highlighted a continuous function and "Following Function" and pressed "Enter." Continuous functions are not linked into the mission network	Press any key to continue, then highlight a different function
Copying function Please Wait	A complete function description is being copied into your working space	Wait until it is done
Copying mission Please Wait	A complete mission description is being copied into your working space	Wait until it is done
Copying scenario Please Wait	A complete scenario description is being copied into your working space	Wait until it is done
Copying subsystem Please Wait	A subsystem and its data are being copied into your working space	Wait until it is done
Copying task Please Wait	A complete task description is being copied into your working space	Wait until it is done
Creating Model Please Wait	The system is building the simulation model	Wait until it is done

MESSAGE	WHAT IT MEANS	WHAT TO DO
ERROR! A task cannot be assigned to a crew member who does not have access to the controls for that task. Press <Enter> to continue	You tried to assign a task to a crew member who was not marked on the previous screen as having access to the task.	Press "Enter" to continue, then either change the assignment or the accessibility
Error opening import file! Hit any key when ready	The import file does not exist	Press any key to continue, then locate your import file and retry
Errors detected. Okay to save? (Y/N)	You have been informed that there are errors in your sequence and you have indicated that you want to save your data. This asks whether you want to save the errors.	Enter "y" or "n" then press "Enter." If you enter "n," you will not exit this step
Fastest must be less than Most Likely! Hit any key to continue	You have specified a "fastest" time that is greater than the "most likely" time	Press any key to continue, then correct this inconsistency
Library data cannot be altered. Any changes will not be saved. Hit any key when ready	You tried to change data that came from the library.	If you want to make changes to library data, you must copy it into either a working mission or a working system first, and then make changes to your copy.
Loading model and data Please Wait	The simulation model is being generated	Wait until it is done
Loading programs and data Please Wait	The programs are being loaded into memory	Wait until it is done
Okay to discard changes? (Y/N)	You have indicated that you want to leave a screen without saving the changes you have made.	Enter either "y" or "n" and press "Enter"

MESSAGE	WHAT IT MEANS	WHAT TO DO
Okay to save changes? (Y/N)	In order to execute the command you have chosen, your current data must be saved to make room for the new screens.	Enter either "y" or "n" and press "Enter"
Processing results Please Wait	The simulation results are being compiled	Wait until it is done
Saving function data Please Wait	Your functions are being stored in the working files	Wait until it is done
Saving mission data Please Wait	Your mission is being stored in the working files	Wait until it is done
Saving scenario data Please Wait	Your scenario description is being stored in the working files	Wait until it is done
Saving subsystem data Please Wait	Your subsystem data are being stored in the working files	Wait until it is done
Saving task data Please Wait	Your tasks are being stored in the working files	Wait until it is done
Start does not have a function type! Hit any key to continue	You have highlighted "Start" and "Function Type" and pressed "Enter." Start must always be a discrete function	Press any key to continue, then highlight a different function
That component name already exists. Enter a name that doesn't exist Hit any key when ready	You have named a new or copied component the same thing as one that is already listed for this subsystem	Press any key to continue
That function name already exists. Enter a name that doesn't exist Hit any key when ready	You have named a new or copied function the same thing as one that is already listed for your mission	Press any key to continue
That is an illegal function! Value not changed Hit any key to continue	You have entered a following function number that does not exist	Press any key to continue, then enter the correct following function

MESSAGE	WHAT IT MEANS	WHAT TO DO
That is an illegal task! Value not changed Hit any key to continue	You have entered a following task number that does not exist lowing task	Press any key to continue, then enter the correct fol-
That is not a legal name! Hit any key to continue	You entered a crew member name that was already listed for your mission	Press any key to continue, then enter a new name
That mission name already exists. Enter a name that doesn't exist Hit any key when ready	You have named a new or copied mission the same thing as one that is already listed for your system	Press any key to continue
That scenario name already exists. Enter a name that doesn't exist Hit any key when ready	You have named a new or copied scenario the same thing as one that is already listed for your system	Press any key to continue
That subsystem name already exists. Enter a name that doesn't exist Hit any key when ready	You have named a new or copied subsystem the same thing as one that is already listed for this system	Press any key to continue
That task name already exists. Enter a name that does not exist Hit any key when ready	You have named a new or copied task the same thing as one that is already listed for this function.	Press any key to continue
WARNING! Functions exist which have multiple or probabilistic decision types but only have one following function. Here is a list of up to 17 functions which have this problem: Press any key to continue	You only entered one following function for functions with probabilistic or multiple decision types	Press any key to continue, then either correct the decision type or add more following functions

MESSAGE	WHAT IT MEANS	WHAT TO DO
WARNING! Non-continuous functions exist which have no path into them. These functions will never be executed. The following is a list of up to 17 functions which have this problem: Press any key to continue	You have functions in your mission that do not have paths leading to them	You must return to the function sequence template and include all functions in the network.
WARNING! - Tasks exist in function # that have no crew members assigned to them. These tasks will never be executed. Here is a list of up to 17 of them: Press <Enter> to continue	You have not assigned crew members to all the tasks in this function	Press "Enter" to continue, then complete the crew member assignment
WARNING! - Tasks exist in function #? that no crew members have access to. These tasks will never be executed. Here is a list of up to 17 of them: Press <Enter> to continue	You have not indicated that any crew members have access to the tasks listed	Press "Enter" to continue, then complete the crew member accessibility information
WARNING! Tasks exist which have multiple or probabilistic decision types but only have one following task. Here is a list of up to 17 tasks which have this problem: Press any key to continue	You only entered one following task for tasks with probabilistic or multiple decision types	Press any key to continue, then either correct the decision type or add more following tasks
WARNING! Tasks exist which have no path into them. These tasks will never be executed. The following is a list of up to 17 tasks which have this problem: Press any key to continue	You have tasks in your function that do not have paths leading to them	You must return to the task sequence template and include all tasks in your function network

MESSAGE	WHAT IT MEANS	WHAT TO DO
Would you like to automatically update the 'fastest' time to maintain the original relationship between the 'most likely' and 'fastest' performance times? (Y/N)	You changed the 'most likely' time estimate. If you want to retain the same standard deviation, the 'fastest' time can be updated automatically	Press "y" or "n"
You must have at least one following function! Hit any key when ready	You tried to delete all the following functions in the list	Press any key to continue, then enter the correct following function
You must have at least one following task! Hit any key when ready	You tried to delete all the following tasks in the list	Press any key to continue, then enter the correct following task

APPENDIX B

DESCRIPTION OF HARDMAN III TOOLS

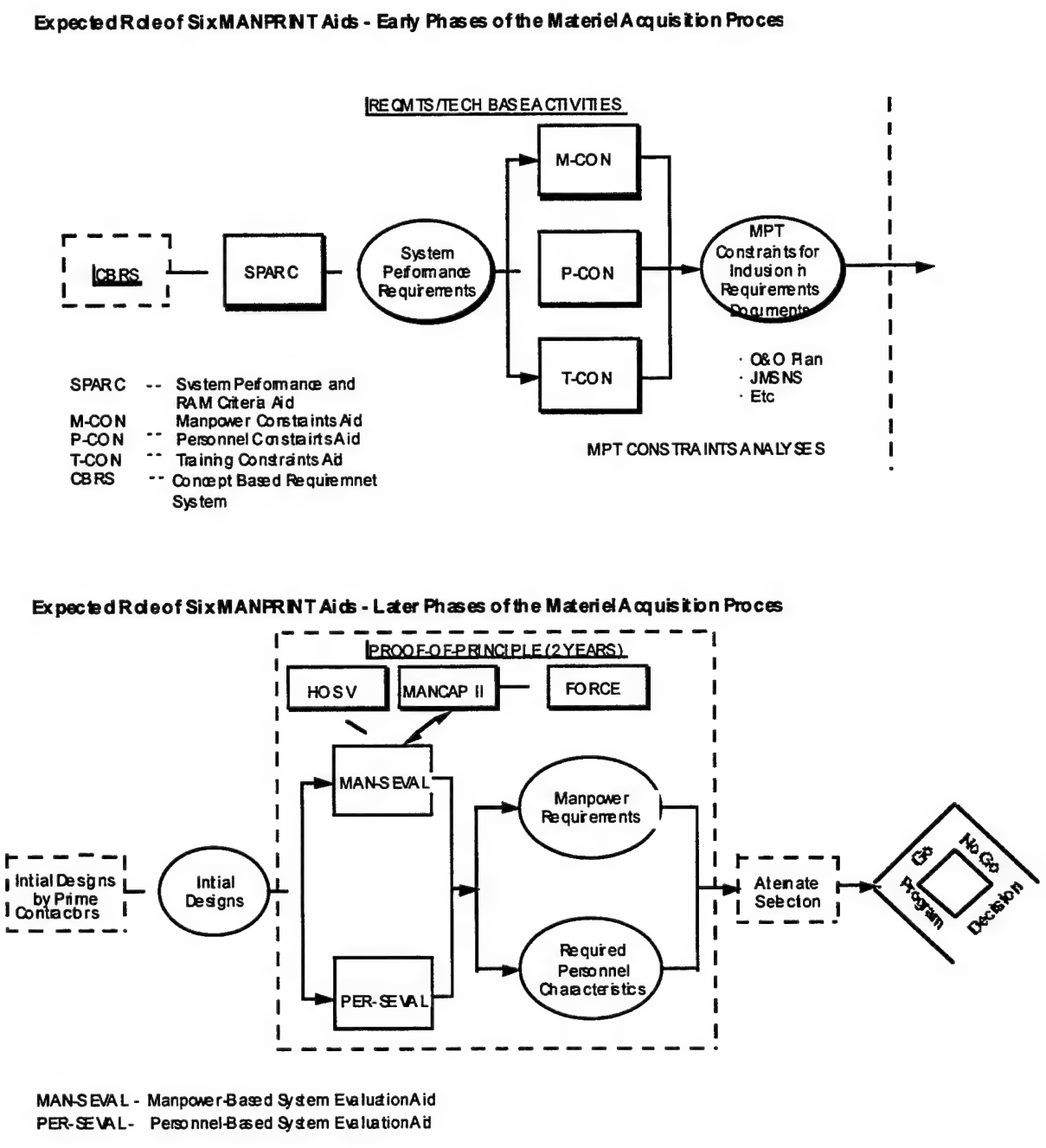

Figure B-1. HARDMAN III aids.

APPENDIX C

USER COMMENTS

USER COMMENTS

HARDMAN III Module: _____

Version: _____ Date: _____

User Name: _____

Organization: _____

Phone: _____

E-Mail: _____

Path (1st line of screen) [If Applicable]:

_____

Menu Title [If Applicable]:

_____

Comments:

_____

_____

_____

_____

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_____

Contact:	Mr. Troy Kelley:	(410)278-5882	tkelley@arl.army.mil
	Ms. Luci Salvi:	(410)278-5814	lsalvi@arl.army.mil
	Ms. Celine Richer	(410)278-5883	cricher@arl.army.mil
	Dr. Laurel Allender:	(410)278-6233	lallende@arl.army.mil

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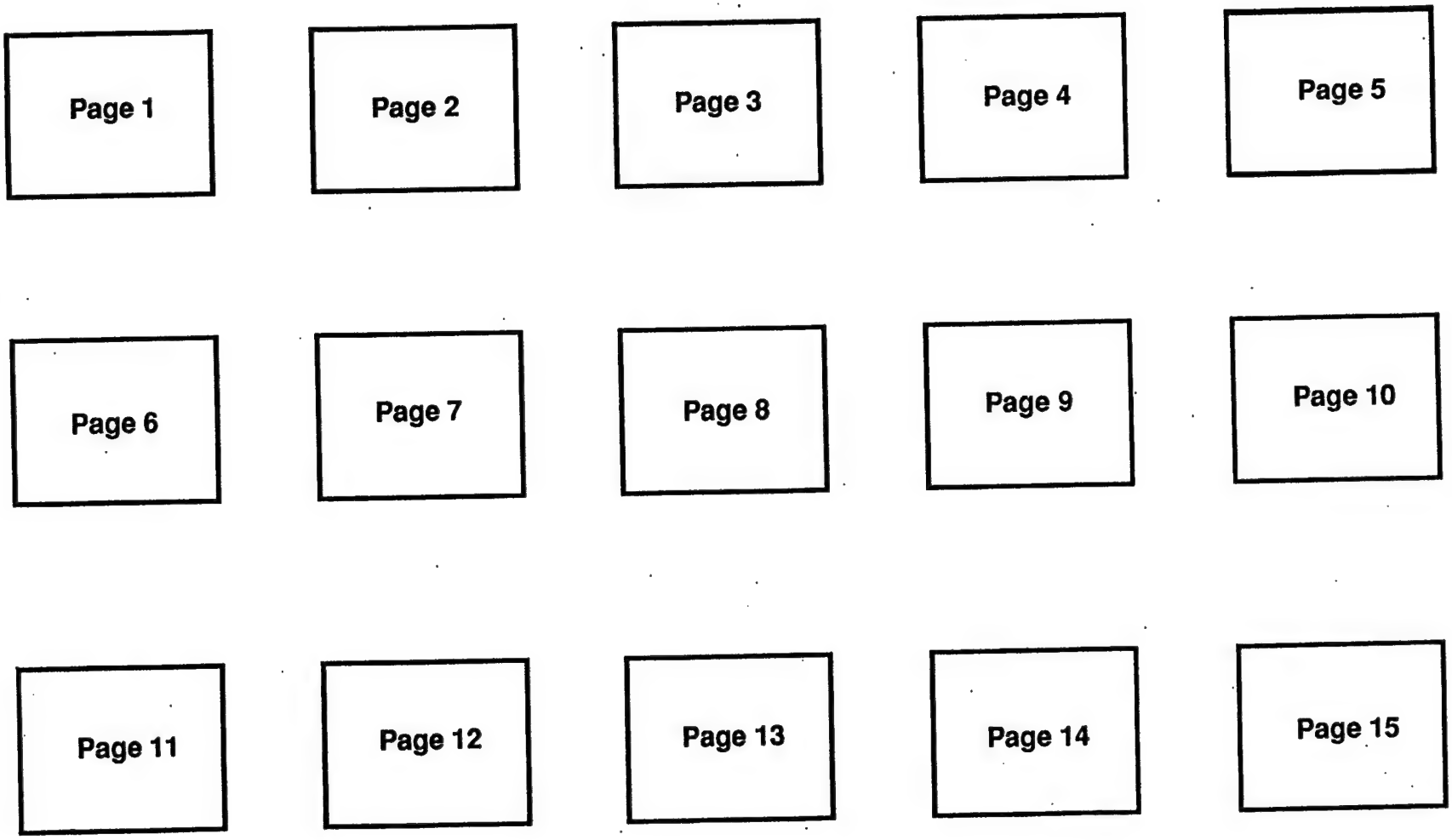
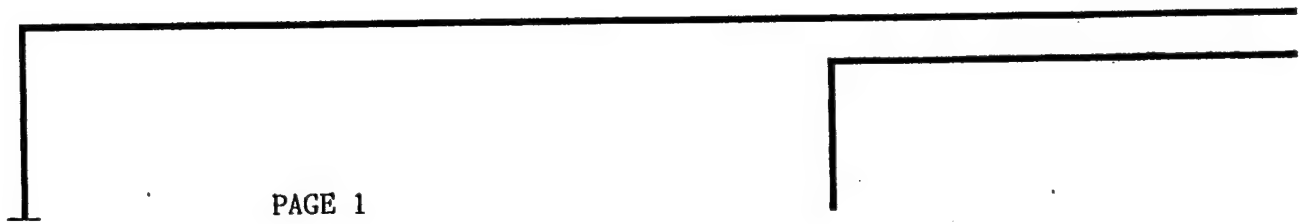
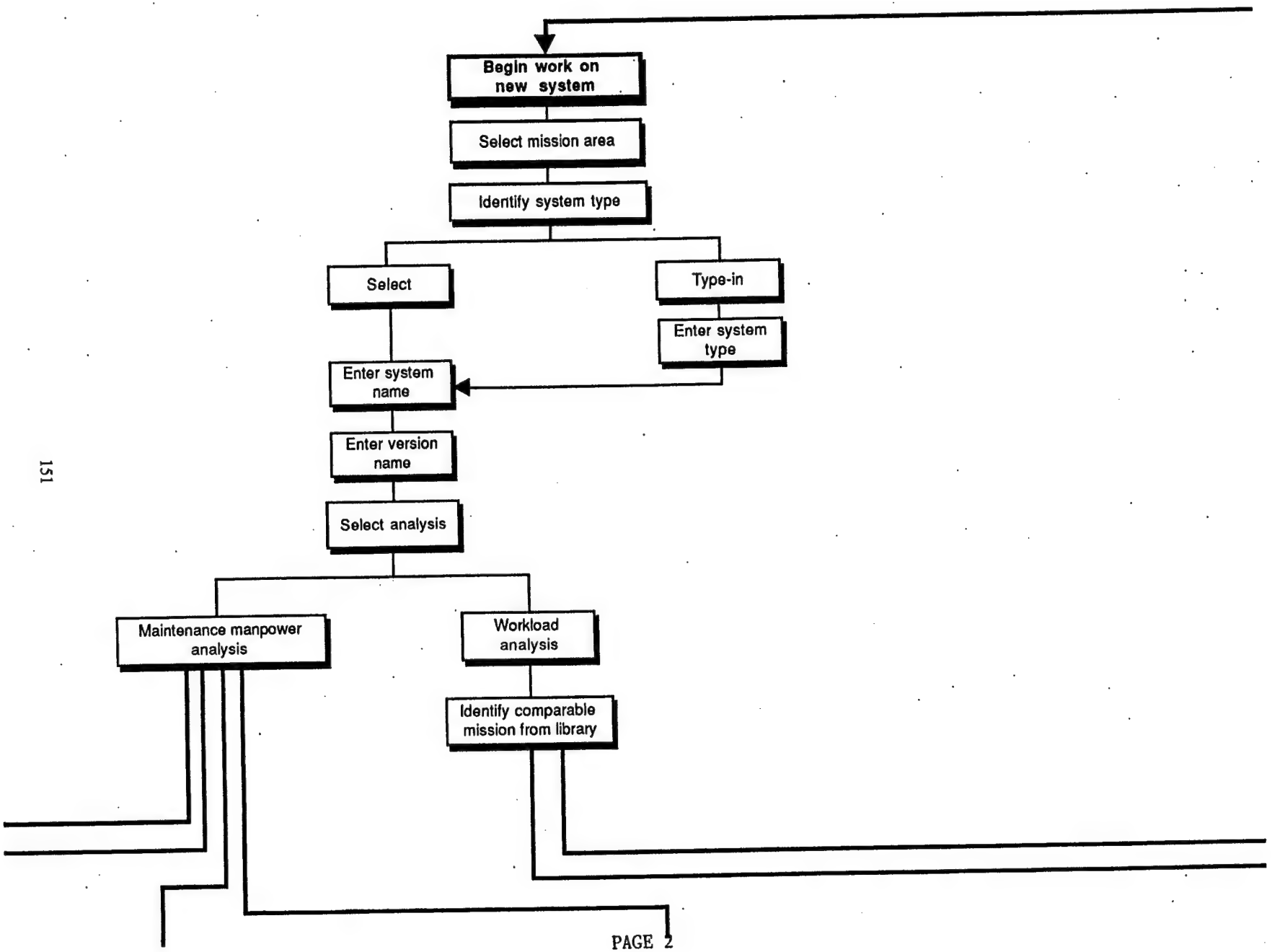
APPENDIX D

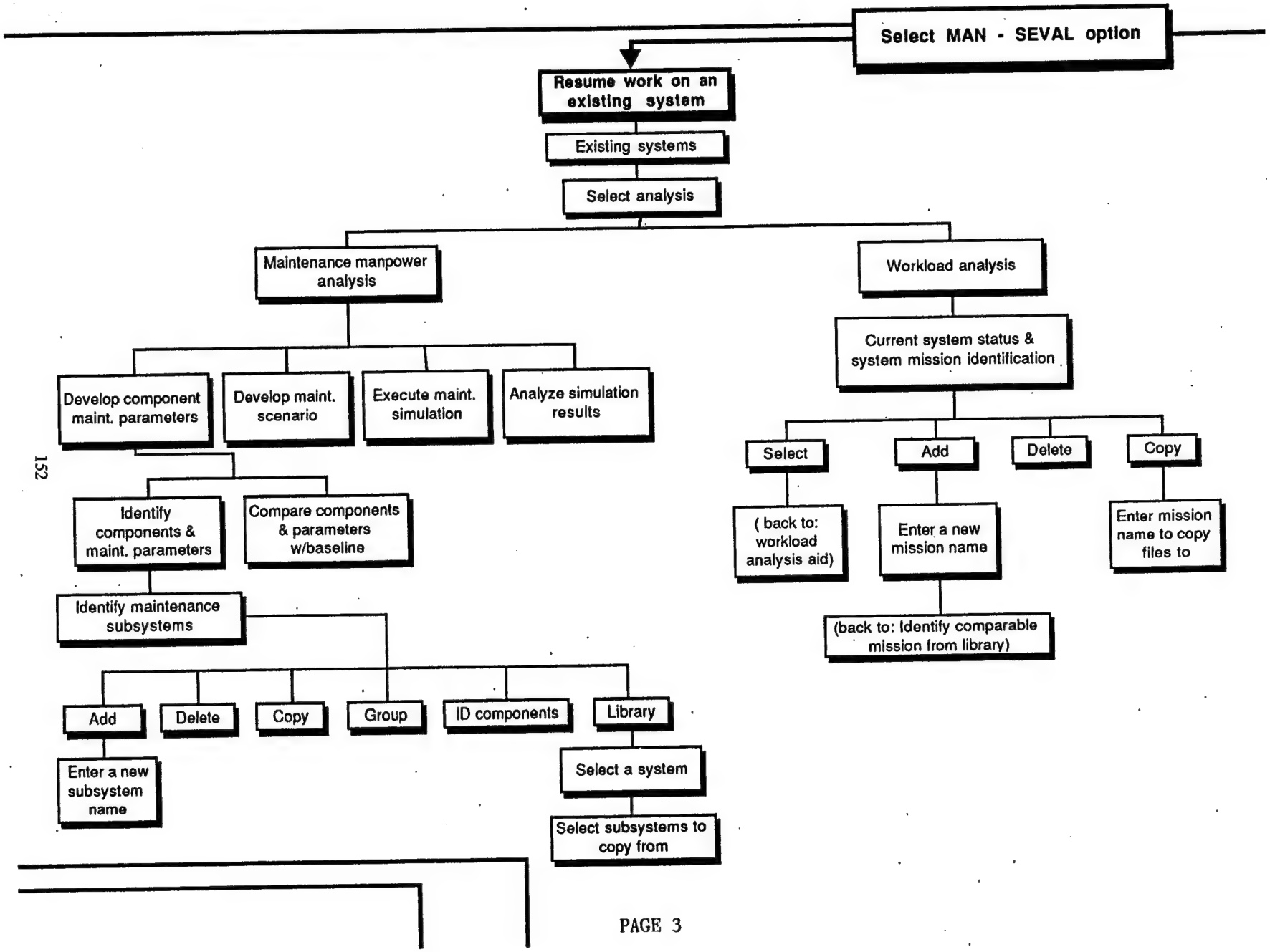
FLOW DIAGRAM OF MAN-SEVAL STEPS

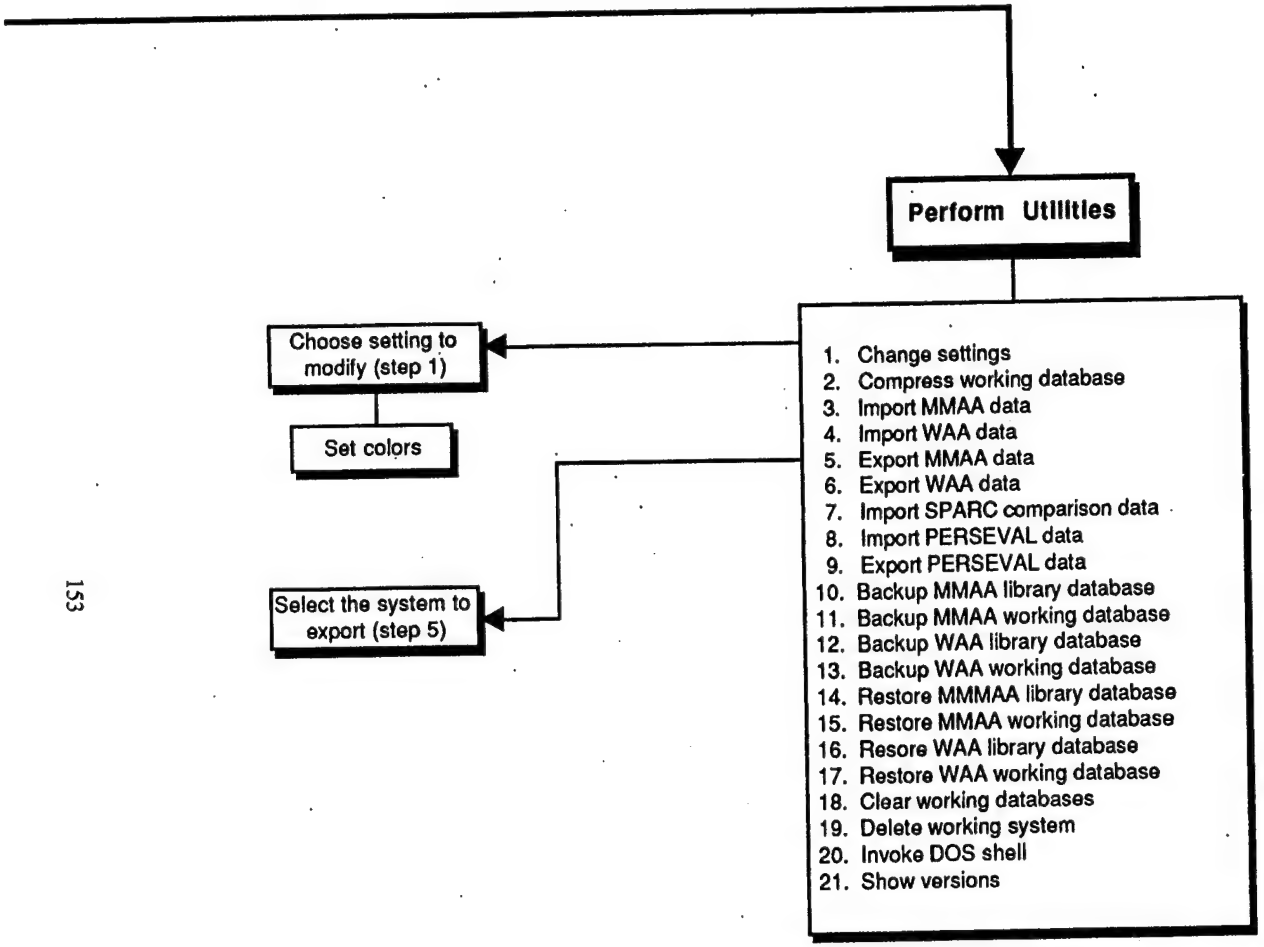
MAN-SEVAL PAGE LAYOUT DIAGRAM

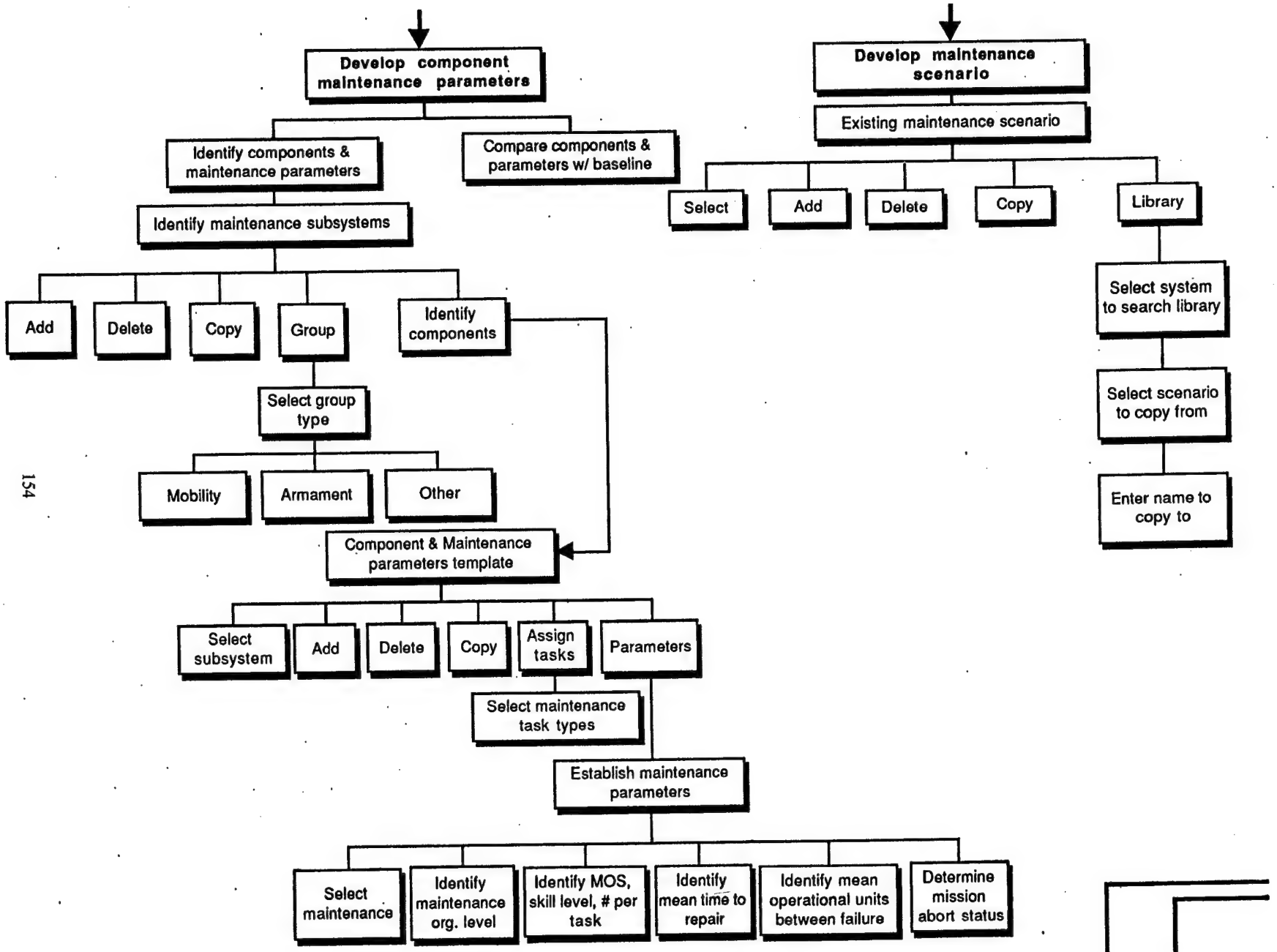


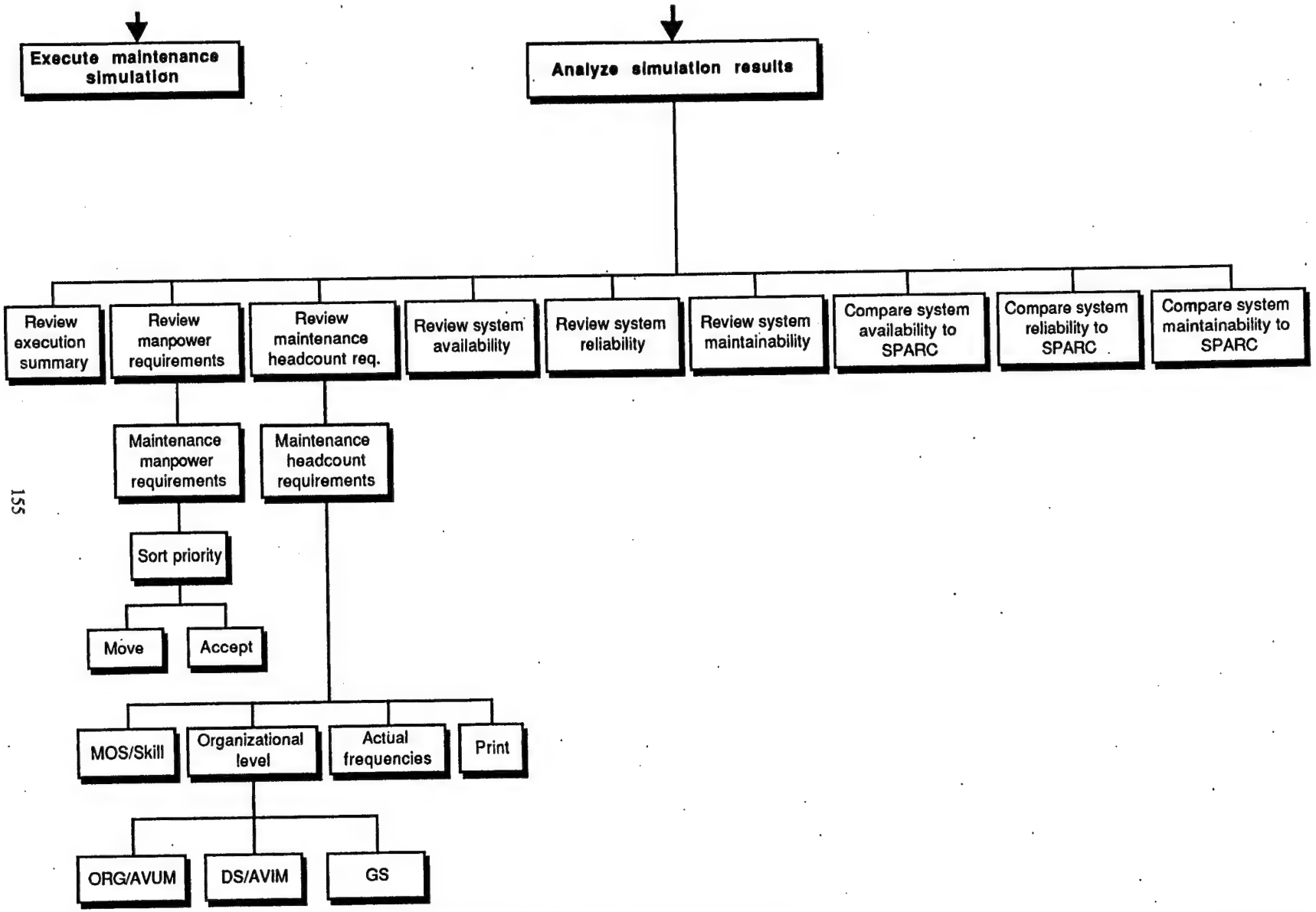


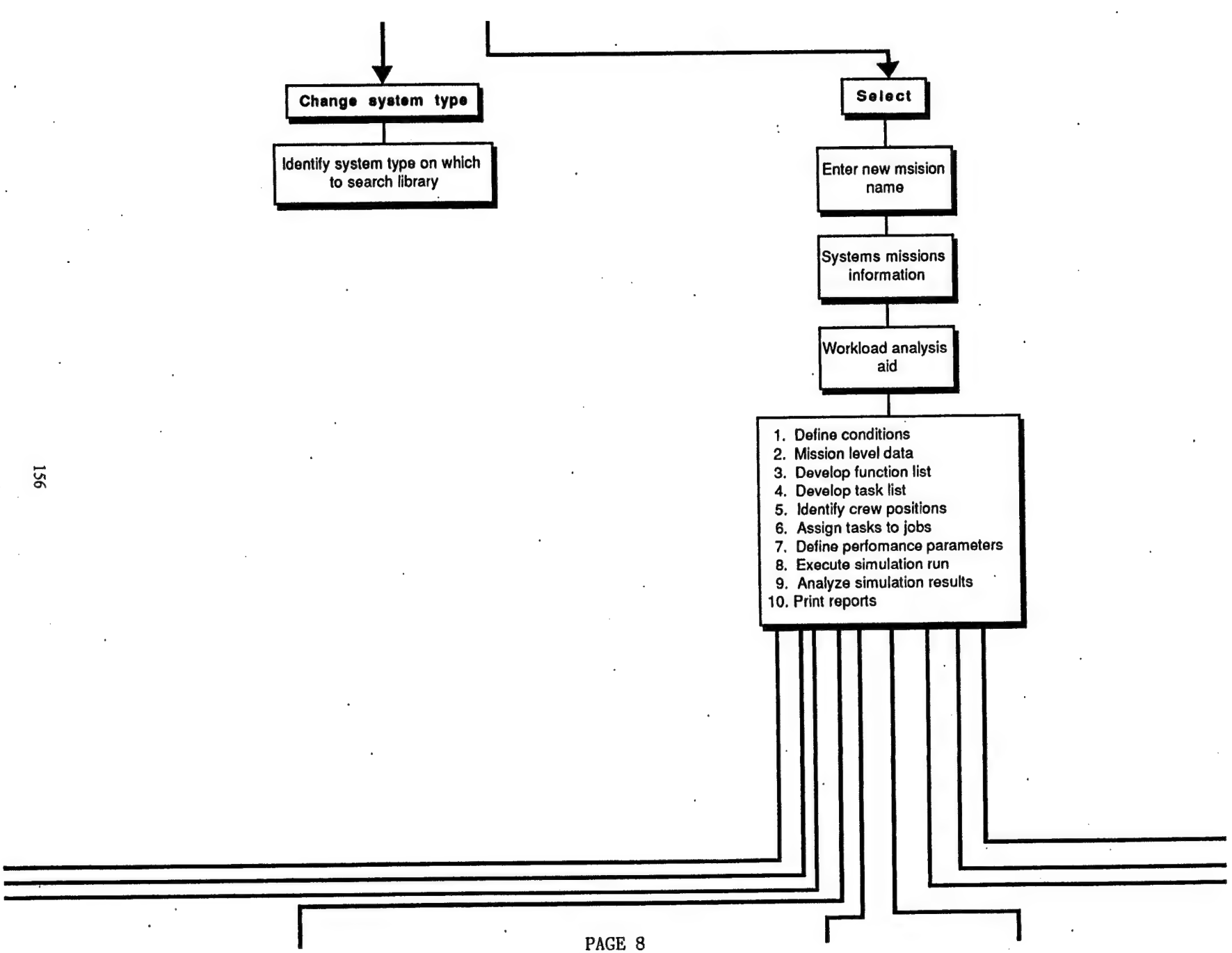

Begin work on new system
Select mission area
Identify system type
Select
Type-in
Enter system type
Enter system name
Enter version name
Select analysis
Maintenance manpower analysis
Workload analysis
Identify comparable mission from library


Select MAN - SEVAL option
Resume work on an existing system
Existing systems
Select analysis
Maintenance manpower analysis
Develop component maint. parameters
Develop maint. scenario
Execute maint. simulation
Analyze simulation results
Identify components & maint. parameters
Compare components & parameters w/baseline
Identify maintenance subsystems
Add
Delete
Copy
Group
ID components
Library
Enter a new subsystem name
Select a system
Select subsystems to copy from
Workload analysis
Current system status & system mission identification
Select
Add
Delete
Copy
(back to: workload analysis aid)
Enter a new mission name
Enter mission name to copy files to
(back to: Identify comparable mission from library)

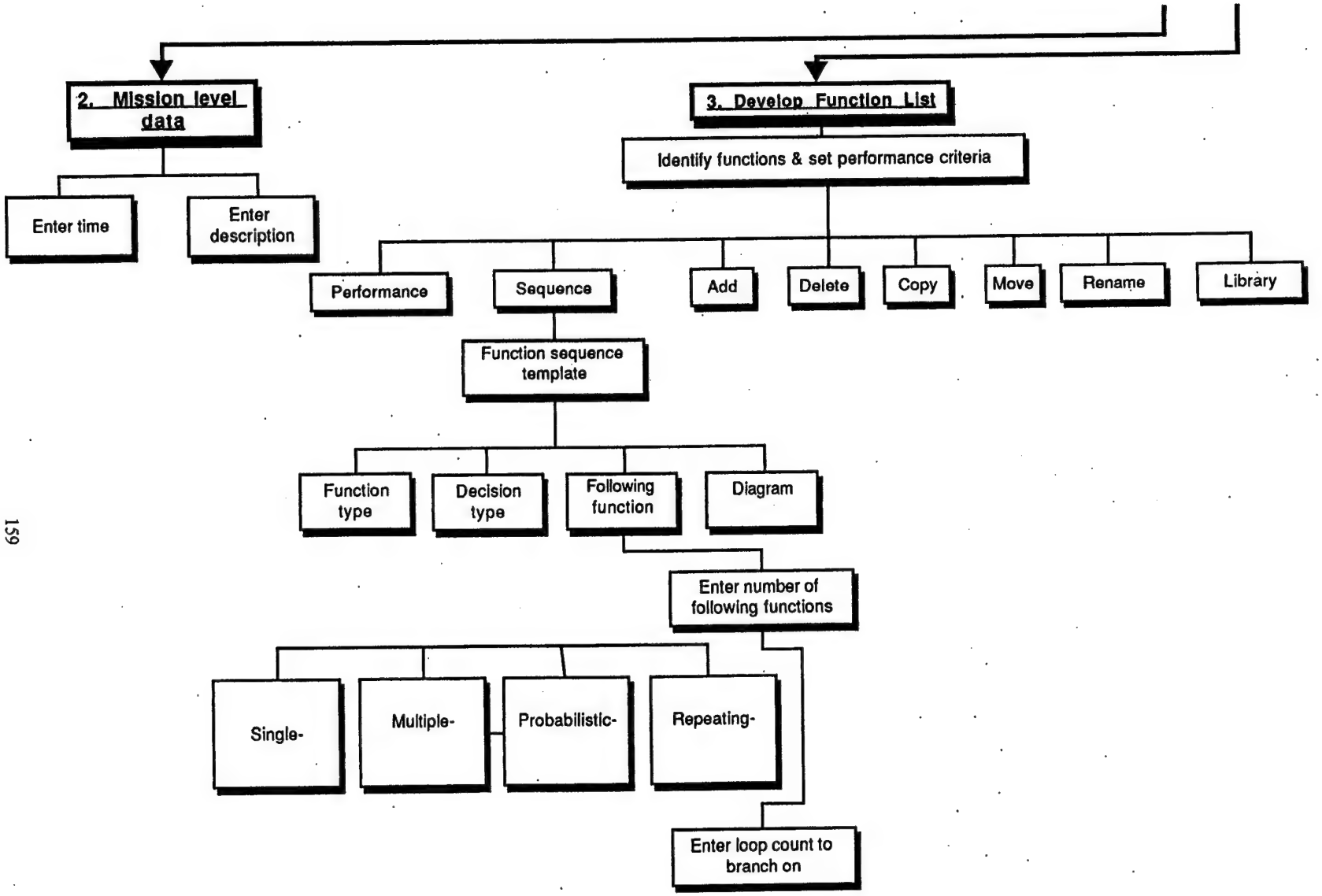

Perform Utilities
Choose setting to modify (step 1)
Set colors
Select the system to export (step 5)
1. Change settings
2. Compress working database
3. Import MMAA data
4. Import WAA data
5. Export MMAA data
6. Export WAA data
7. Import SPARC comparison data
8. Import PERSEVAL data
9. Export PERSEVAL data
10. Backup MMAA library database
11. Backup MMAA working database
12. Backup WAA library database
13. Backup WAA working database
14. Restore MMMAA library database
15. Restore MMAA working database
16. Resore WAA library database
17. Restore WAA working database
18. Clear working databases
19. Delete working system
20. Invoke DOS shell
21. Show versions


Develop component maintenance parameters
Identify components & maintenance parameters
Compare components & parameters w/ baseline
Identify maintenance subsystems
Add
Delete
Copy
Group
Identify components
Select group type
Mobility
Armament
Other
Component & Maintenance parameters template
Select subsystem
Add
Delete
Copy
Assign tasks
Parameters
Select maintenance task types
Establish maintenance parameters
Select maintenance
Identify maintenance org. level
Identify MOS, skill level, # per task
Identify mean time to repair
Identify mean operational units between failure
Determine mission abort status
Develop maintenance scenario
Existing maintenance scenario
Select
Add
Delete
Copy
Library
Select system to search library
Select scenario to copy from
Enter name to copy to

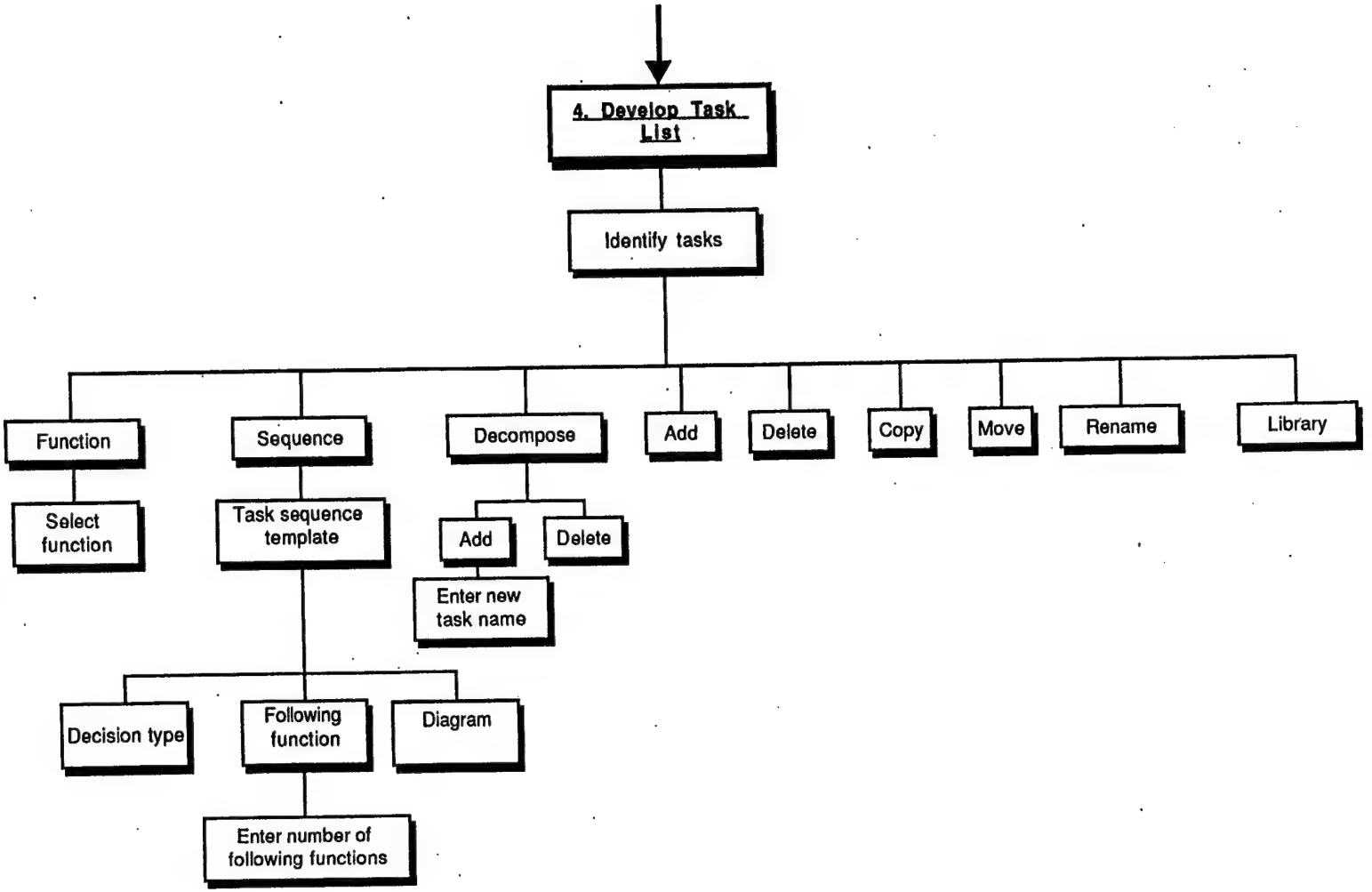

Execute maintenance simulation
Analyze simulation results
Review execution summary
Review manpower requirements
Review maintenance headcount req.
Review system availability
Review system reliability
Review system maintainability
Compare system availability to SPARC
Compare system reliability to SPARC
Compare system maintainability to SPARC
Maintenance manpower requirements
Maintenance headcount requirements
Sort priority
Move
Accept
MOS/Skill
Organizational level
Actual frequencies
Print
ORG/AVUM
DS/AVIM
GS

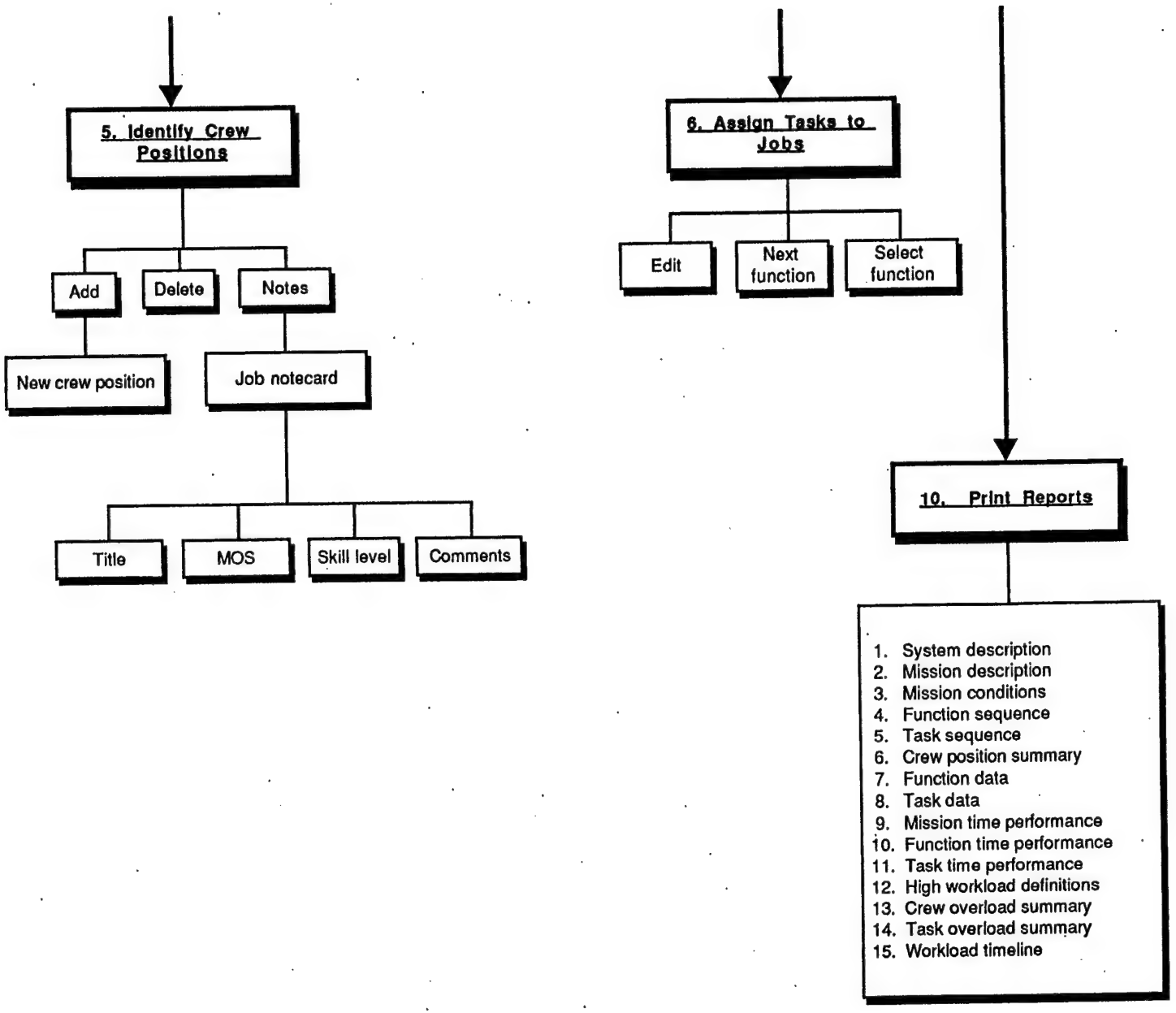

Change system type
Identify system type on which to search library
Select
Enter new msision name
Systems missions information
Workload analysis aid
1. Define conditions
2. Mission level data
3. Develop function list
4. Develop task list
5. Identify crew positions
6. Assign tasks to jobs
7. Define perfomance parameters
8. Execute simulation run
9. Analyze simulation results
10. Print reports

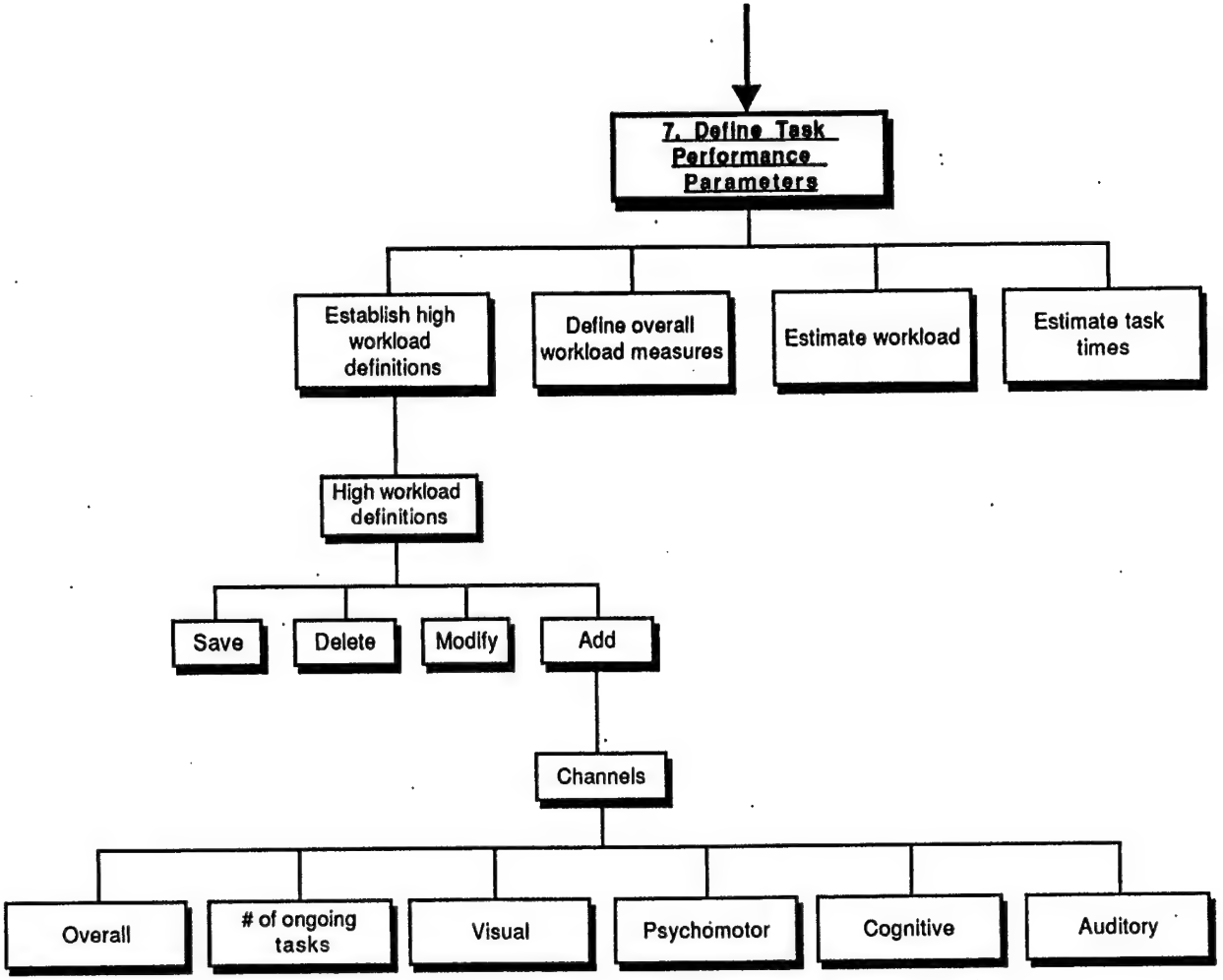
PAGE 10

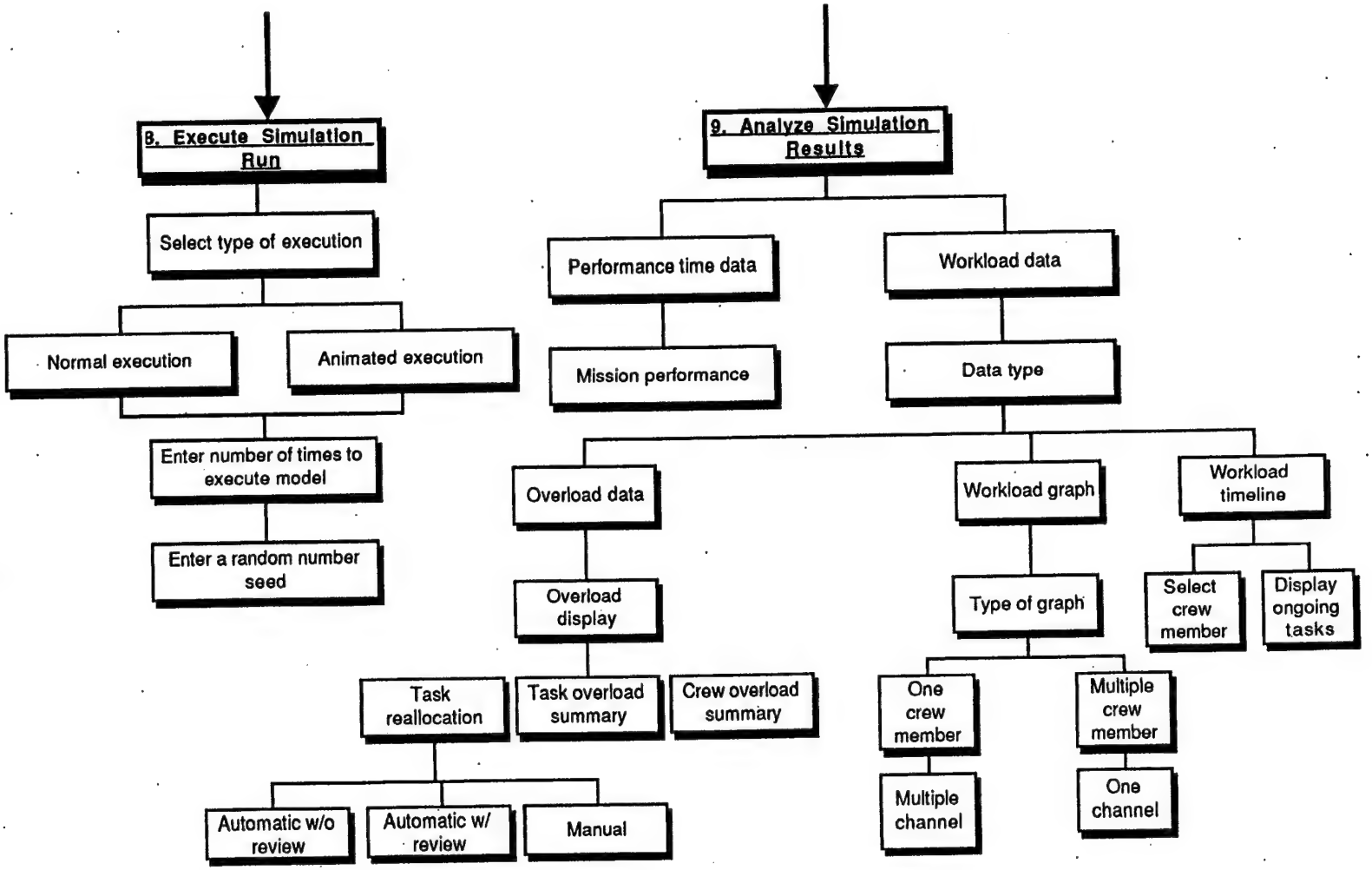

2. Mission level data
Enter time
Enter description
3. Develop Function List
Identify functions & set performance criteria
Performance
Sequence
Add
Delete
Copy
Move
Rename
Library
Function sequence template
Function type
Decision type
Following function
Diagram
Enter number of following functions
Single-
Multiple-
Probabilistic-
Repeating-
Enter loop count to branch on

159


4. Develop Task List
Identify tasks
Function
Sequence
Decompose
Add
Delete
Copy
Move
Rename
Library
Select function
Task sequence template
Add
Delete
Enter new task name
Decision type
Following function
Diagram
Enter number of following functions


5. Identify Crew Positions
Add
Delete
Notes
New crew position
Job notecard
Title
MOS
Skill level
Comments
6. Assign Tasks to Jobs
Edit
Next function
Select function
10. Print Reports
1. System description
2. Mission description
3. Mission conditions
4. Function sequence
5. Task sequence
6. Crew position summary
7. Function data
8. Task data
9. Mission time performance
10. Function time performance
11. Task time performance
12. High workload definitions
13. Crew overload summary
14. Task overload summary
15. Workload timeline


7. Define Task Performance Parameters
Establish high workload definitions
Define overall workload measures
Estimate workload
Estimate task times
High workload definitions
Save
Delete
Modify
Add
Channels
Overall
# of ongoing tasks
Visual
Psychomotor
Cognitive
Auditory


8. Execute Simulation Run
Select type of execution
Normal execution
Animated execution
Enter number of times to execute model
Enter a random number seed
9. Analyze Simulation Results
Performance time data
Mission performance
Workload data
Data type
Overload data
Overload display
Task reallocation
Task overload summary
Crew overload summary
Automatic w/o review
Automatic w/ review
Manual
Workload graph
Type of graph
One crew member
Multiple channel
Multiple crew member
One channel
Workload timeline
Select crew member
Display ongoing tasks

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